Mk7 M.M.

Installation and Commissioning Guide

AUTOFLAME®

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THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2007

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Important Notes

A knowledge of combustion related procedures and commissioning is essential before embarking work on any of the M.M./E.G.A. systems. This is for safety reasons and effective use of the M.M./ E.G.A. system. Hands on training is required. For details on schedules and fees relating to group training courses and individual instruction, please contact the Autoflame Engineering Ltd. offices at the address listed on the front.

Short Form - General Terms and Conditions

A full statement of our business terms and conditions are printed on the reverse of all invoices. A copy of these can be issued upon application, if requested in writing.

The System equipment and control concepts referred to in this Manual MUST be installed, commissioned and applied by personnel skilled in the various technical disciplines that are inherent to the Autoflame product range, i.e. combustion, electrical and control.

The sale of Autoflame's systems and equipment referred to in this Manual assume that the dealer, purchaser and installer has the necessary skills at his disposal. i.e. A high degree of combustion engineering experience, and a thorough understanding of the local electrical codes of practice concerning boilers, burners and their ancillary systems and equipment.

Autoflame's warranty from point of sale is two years on all electronic systems and components.
One year on all mechanical systems, components and sensors.

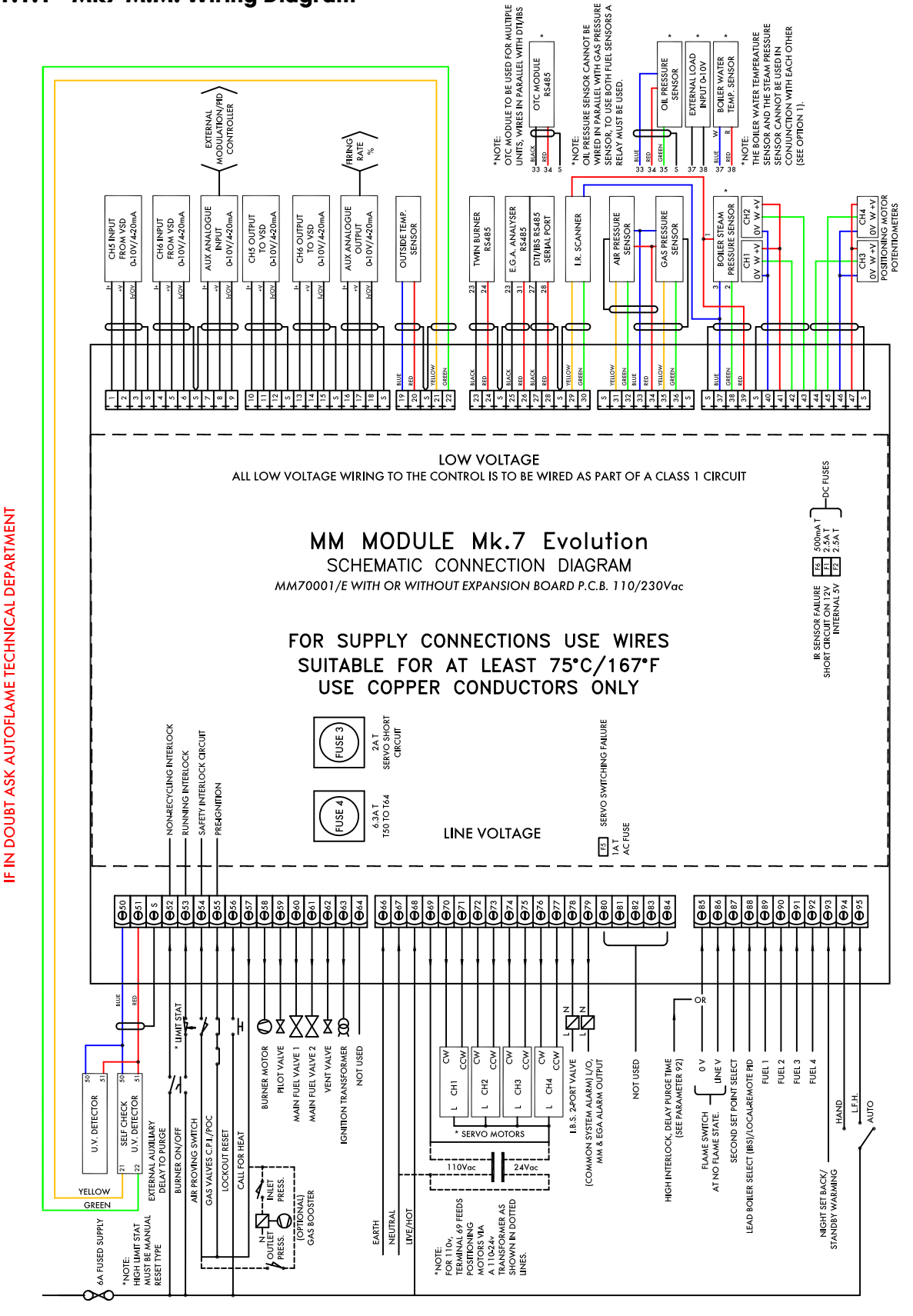
The warranty assumes that all equipment supplied will be used for the purpose that it was intended and in strict compliance with our technical recommendations. Autoflame's warranty and guarantee is limited strictly to product build quality, and design. Excluded absolutely are any claims arising from misapplication, incorrect installation and/or incorrect commissioning.

Contents

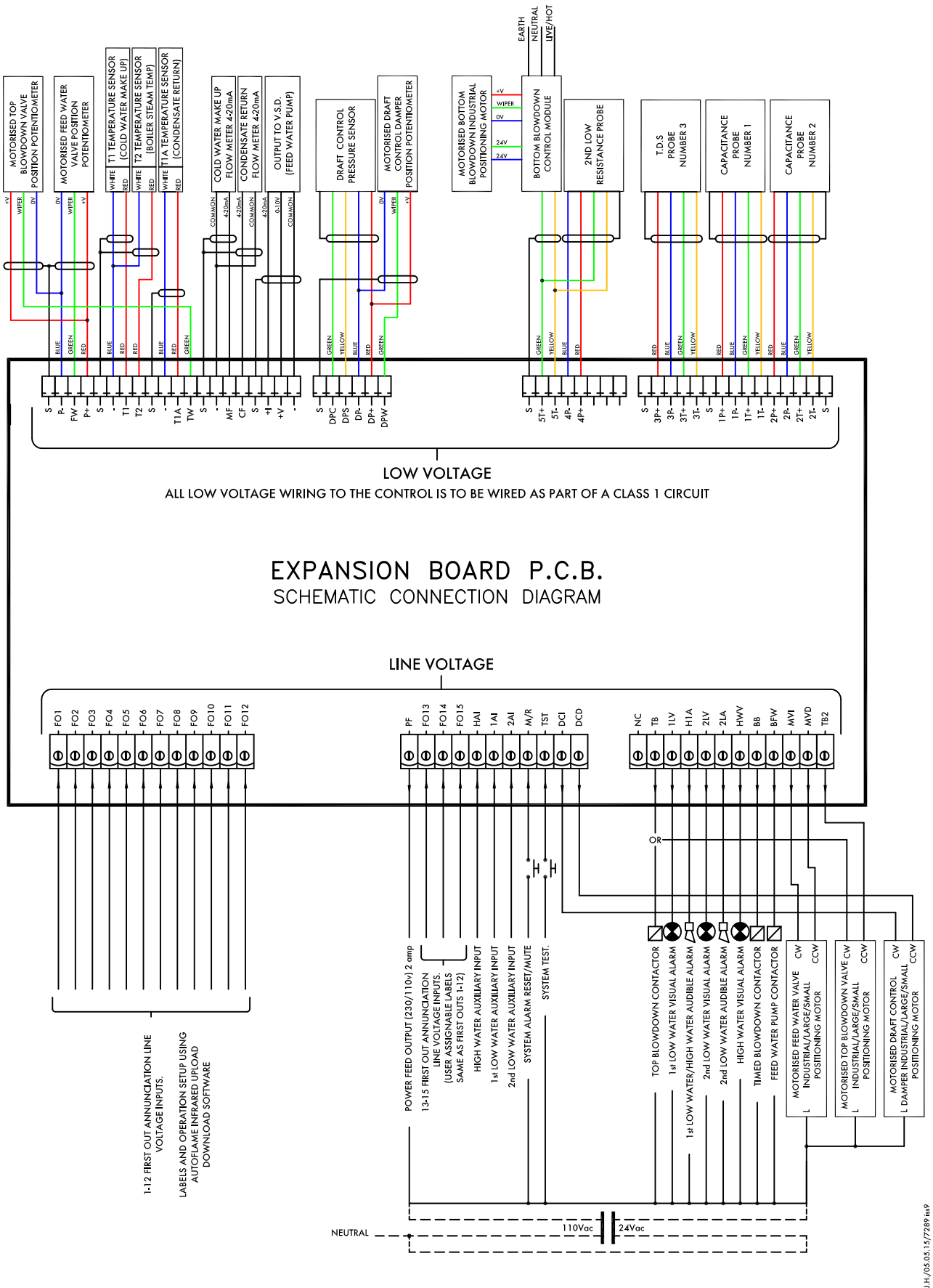
1 WIRING

1.1 Wiring Schematics

1.1.1 Mk7 M.M. Wiring Diagram



1.1.2 Expansion PCB Wiring Diagram



1.2 Electrical Specifications

1.2.1 Classifications

Classification according to EN298 – F B L L J B

Mains Supply:	230V, +10%/-15%} 110V, +10%/-15%}	47-63 Hz, unit max. consumption 62W
Max Leakage:	3.5mA	
Climate:	Temperature	0 to +40°C (32 to 104°F)
	Humidity	0 to 90% non-condensing
Storage:	Temperature	-20 to 85°C (-4 to 185°F)
Protection Rating:	The unit is designed to be panel mounted in any orientation and the front facia is IP65, NEMA4. The back of the unit is IP20, NEMA1.	

1.2.2 Inputs and Outputs

Inputs and Outputs

230V Unit:

Outputs	Terminal	57	250mA	Must be connected through contactor	
		58	250mA	Must be connected through contactor	
		59	1A	0.6 power factor	
		60	1A	0.6 power factor	
		61	1A	0.6 power factor	Max Load 6A
		62	1A	0.6 power factor	
		63	1A	0.6 power factor	
		78	100mA	To drive relay only – switched neutral	
		79	100mA	To drive relay/lamp only – switched neutral	

Analogue I/Os 240Ω or less

110V Unit:

Outputs	Terminal	57	250mA	Must be connected through contactor	
		58	250mA	Must be connected through contactor	
		59	2A	0.6 power factor	
		60	2A	0.6 power factor	
		61	2A	0.6 power factor	Max Load 6A
		62	2A	0.6 power factor	
		63	2A	0.6 power factor	
		78	100mA	To drive relay only – switched neutral	
		79	100mA	To drive relay/lamp only – switched neutral	

Analogue I/Os 240Ω or less

Max Load 2A on Expansion Board terminal PF

Note:

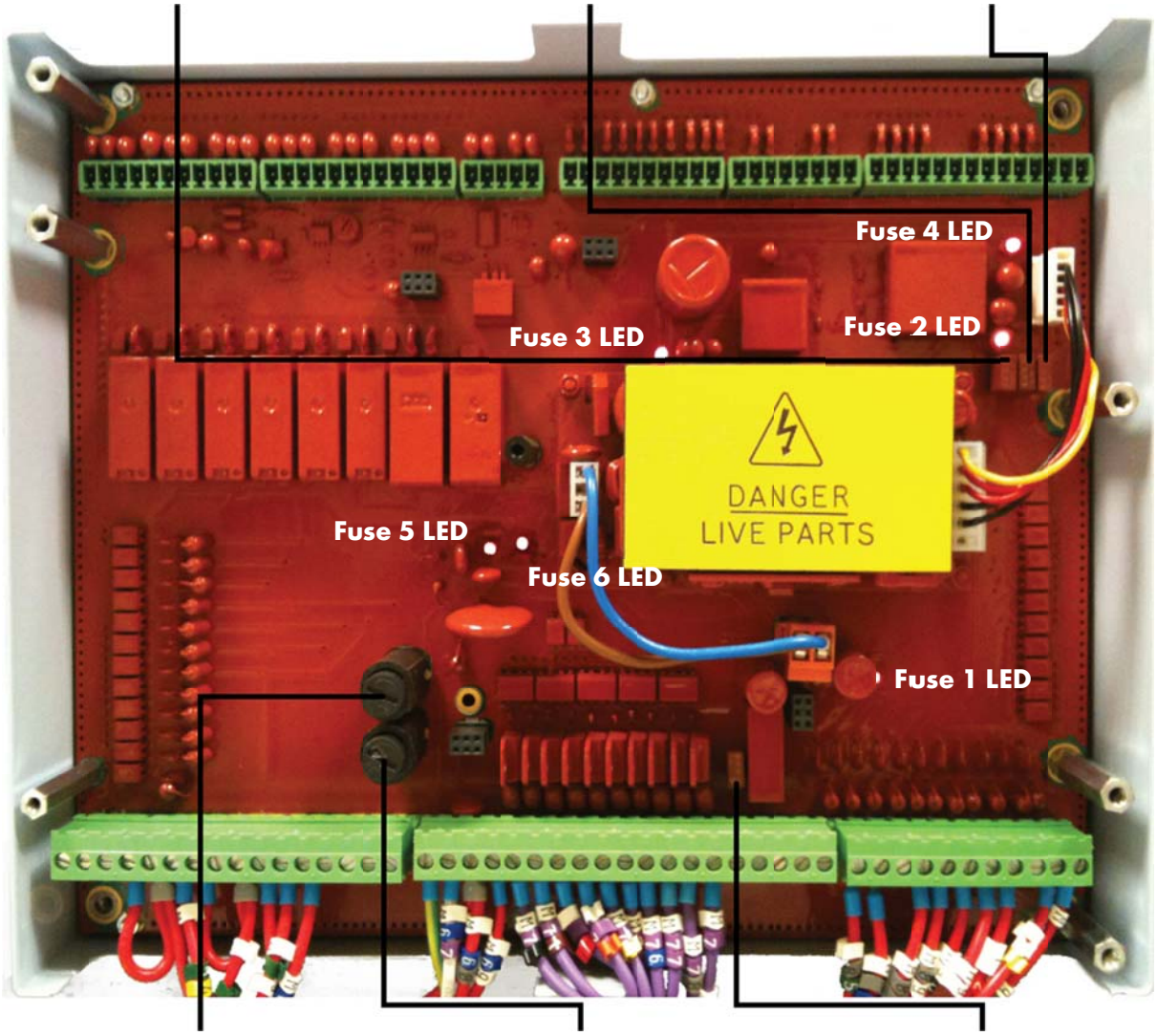
1. The high and low voltage connections are not safe to touch. Protection against electric shock is provided by correct installation. **CAUTION – ELECTRIC SHOCK HAZARD.**
2. Cabling should be maximum 25m.
3. Use screened cable as specified in section 1.2.4.
4. The burner 'High Limit Stat' must be of the manual reset type.

1.2.3 Fuse Ratings

Fuse 6 - 500mA(T) Time lag
Part No. FU10040
(IR Sensor failure/ Terminals 37 – 39 Failure)

Fuse 1 - 2.5A(T) Time lag
Part No. FU10042
(Short Circuit on 12V)

Fuse 2 - 2.5A(T) Time lag
Part No. FU10042
(Internal 5V)



Fuse 3 - 2A(T) Time lag
Part No. FU10034
(Servo Short Circuit)

Fuse 4 - 6.3A(T) Time lag
Part No. FU10026
(Terminals 50 to 64)

Fuse 5 - 1A(T) Time lag
Part No. FU10041
(Servo AC Switching failure)

Text in brackets indicates possible causes of fuse blowing.

All fuses should be time lag type (T).

If a fuse LED is extinguished, then this indicates that the fuse has blown.

1.2.4 Cable Specifications

Screened Cable

The screened cable used from the M.M. to the servomotors and detectors must conform to the following specification:

16/0.2mm PVC insulated overall braid, screened, PVC sheathed.

- Sixteen wires per core
- Diameter of wires in each core 0.2mm
- Rated at 440V AC rms at 1600Hz
- DEF 61-12 current rating per core 2.5A
- Maximum operating temperature 70°C (158°F)
- Nominal conductor area 0.5sq mm per core
- Nominal insulation radial thickness on core 0.45mm
- Nominal conductor diameter per core 0.93mm
- Nominal core resistance at 20°C. 40.1Ω/1000m
- Nominal overall diameter per core 1.83mm
- Fill factor of braid screen 0.7
- Equivalent imperial conductor sizes 14/0.0076

Use the number of cores suitable for the application. A universal part numbering system appears to have been adopted for this type of cable as follows:

16-2-2C 2 Core
16-2-3C 3 Core
16-2-4C 4 Core
16-2-6C 6 Core

(5 Core not readily available)

Note: If using 4 Core cable and interference is detected, use 2 sets of 2 Core.

Data Cable

Data cable must be used for connections between M.M.s for twin burner/sequencing applications and between M.M.s and E.G.A.s and for connection between M.M.s and D.T.I.

Types of data cable that can be used:

1 Beldon 9501 for 2-core shielded cable (1 twisted pair)
2 Beldon 9502 for 4-core shielded cable (2 twisted pairs)
3 STC OS1P24

Samples are available upon request.

Cables can be ordered directly from Autoflame Engineering, please contact Autoflame Sales.

1.2.5 Terminals Description

S	All terminals marked S are internally connected. They are provided for connections to the various screened cables. Refer to the schematic connection diagrams, section 1.3, 1.4, and 1.5.
1	Current Input, 4-20mA. For channel 5 VSD use only. Can be connected to the current output of a VSD or tachometer system as appropriate
2	Voltage Input, 0-10V. For channel 5 VSD use only. Can be connected to the voltage output of a VSD or tachometer system as appropriate
3	Common for Terminals 1 or 2
4	Current Input, 4-20mA. For channel 6 VSD use only. Can be connected to the current output of a VSD or tachometer system as appropriate
5	Voltage Input, 0-10V. For channel 6 VSD use only. Can be connected to the voltage output of a VSD or tachometer system as appropriate
6	Common for Terminals 4 or 5
7	Current Input, 4-20mA. Used for external modulation or external required setpoint
8	Voltage Input, 2-10V. Used for external modulation or external required setpoint
9	Common for Terminals 7 or 8
10	Current Output, 4-20mA. For channel 5 VSD use only. Can be connected to the current input of a VSD
11	Voltage Output, 0-10V. For channel 5 VSD use only. Can be connected to the voltage input of a VSD
12	Common for Terminals 10 or 11
13	Current Output, 4-20mA. For channel 6 VSD use only. Can be connected to the current input of a VSD
14	Voltage Output, 0-10V. For channel 6 VSD use only. Can be connected to the voltage input of a VSD
15	Common for Terminals 13 or 14
16	Current Output, 4-20mA. Varies in accordance with firing rate
17	Voltage Output, 0-10V. Varies in accordance with firing rate
18	0V common for Terminals 16 or 17

Note that all the common Terminals (3, 6, 9, 12, 15, 18) are connected to each other internally. All of the circuitry, associated with the analogue inputs and outputs detailed above, are isolated from earth/ground potential, i.e. floating.

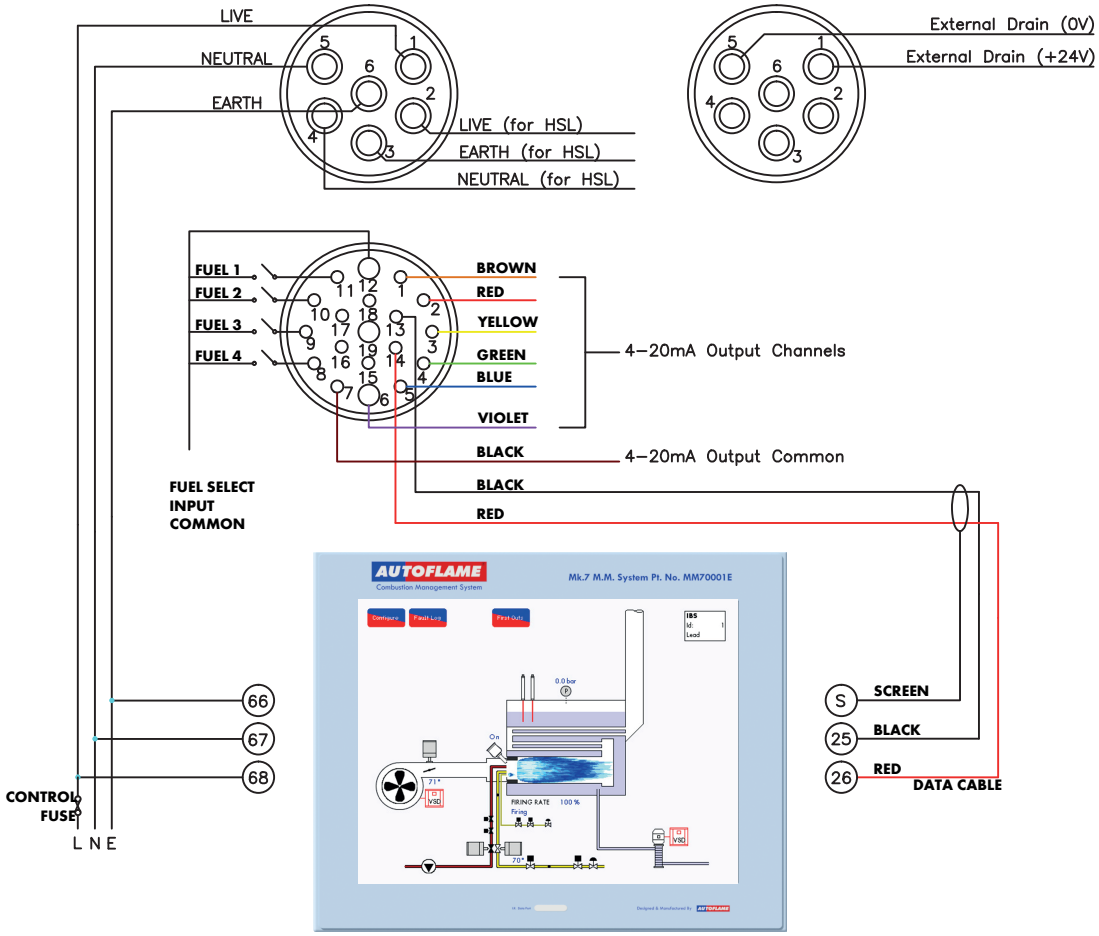
19, 20	Connections to an Autoflame outside temperature sensor (options 80-85)
21, 22	Connections to an Autoflame self-check UV sensor
23, 24	Communications port connections for twin burner operation
25, 26	Communications port connections to an Exhaust Gas Analyser (E.G.A.)
27, 28	Communications port connections for Data Transfer Interface (D.T.I.) and/or Intelligent Boiler Sequencing operation
29, 30	Connections to an Autoflame Self check IR sensor (M10017)
31, 32	Signal inputs from Autoflame air pressure sensor
33	0V supply to Autoflame air/gas/(oil) pressure sensors
34	+12V supply to Autoflame air/gas/(oil) pressure sensors
35, 36 (35)	Signal inputs from Autoflame gas pressure sensor (oil)
37, 38 (39)	Connections to an Autoflame boiler temperature detector (pressure)
40	0V supply to channel 1 and channel 2 servomotors
41	+12V supply to channel 1 and channel 2 servomotors
42	Signal from channel 1 servomotor, indicating position
43	Signal from channel 2 servomotor, indicating position
44	Signal from channel 3 servomotor, indicating position
45	Signal from channel 4 servomotor, indicating position
46	0V Supply to channel 3 and channel 4 servomotors
47	+12V Supply to channel 3 and channel 4 servomotors
48, 49	No terminals allocated
50,51	Connections to an Autoflame UV sensor
52	Mains voltage input- external auxiliary delay to purge
53	Mains voltage input- burner on/off signal, running interlock circuit
54	Mains voltage input- safety circuits, e.g. air proving
55	Mains voltage input- proving circuits, e.g. gas valve proof of closure
56	Mains voltage input- lockout reset
57	Mains voltage output- call for heat

58	Mains voltage output- burner motor
59	Mains voltage output- start/pilot valve
60	Mains voltage output- main fuel valve 1
61	Mains voltage output- main fuel valve 2
62	Mains voltage output- vent valve
63	Mains voltage output- ignition transformer
64	Unused – do not connect
65	No terminal allocated
66	Mains supply- earth
67	Main supply- neutral
68	Mains supply- live/hot
69	Mains voltage output, power to servomotors
70	Switched neutral- drives channel 1 servomotor clockwise
71	Switched neutral- drives channel 1 servomotor counter clockwise
72	Switched neutral- drives channel 2 servomotor clockwise
73	Switched neutral- drives channel 2 servomotor counter clockwise
74	Switched neutral- drives channel 3 servomotor clockwise
75	Switched neutral- drives channel 3 servomotor counter clockwise
76	Switched neutral- drives channel 4 servomotor clockwise
77	Switched neutral- drives channel 4 servomotor counter clockwise
78	Switched neutral-to drive 2-port valve for IBS/lead-lag operation
79	Switched neutral- alarm output for M.M. lockout/M.M. error/E.G.A. error.
80	Unused- do not connect
81	Unused- do not connect
82	Unused- do not connect
83	Unused- do not connect
84	Unused- do not connect

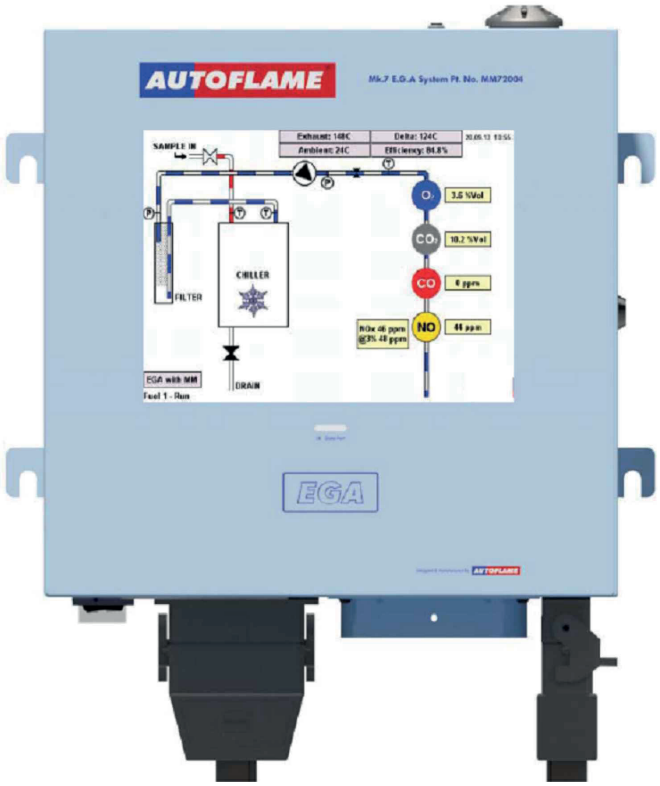
85	Mains voltage input. For use when using an external flame switch- 0V when at no flame state, or when using boiler differential proving (parameter 92)
86	Mains voltage input. For use when using an external flame switch- line voltage when at no flame state
87	Mains voltage input. Select second required setpoint- second set-point facility
88	Mains voltage input. Can be used to select this M.M. as lead boiler when Intelligent Boiler Sequencing is implemented. If this terminal is used to select the lead boiler, it will take priority over a lead boiler set via the D.T.I. Also used as an input to select between internal and external modulation using external PID loop (or option 55)
89	Mains voltage input- selects fuel 1 curve
90	Mains voltage input- selects fuel 2 curve
91	Mains voltage input- selects fuel 3 curve
92	Mains voltage input- selects fuel 4 curve
93	Mains voltage input- if low pressure steam operation is optioned, this input is used to detect low boiler temperature (by means of an appropriate temperature switch/aquastat). If outside temperature compensation is optioned, this input is used to activate the night setback
94	Mains voltage input- selects hand operation
95	Mains voltage input- selects low flame hold operation

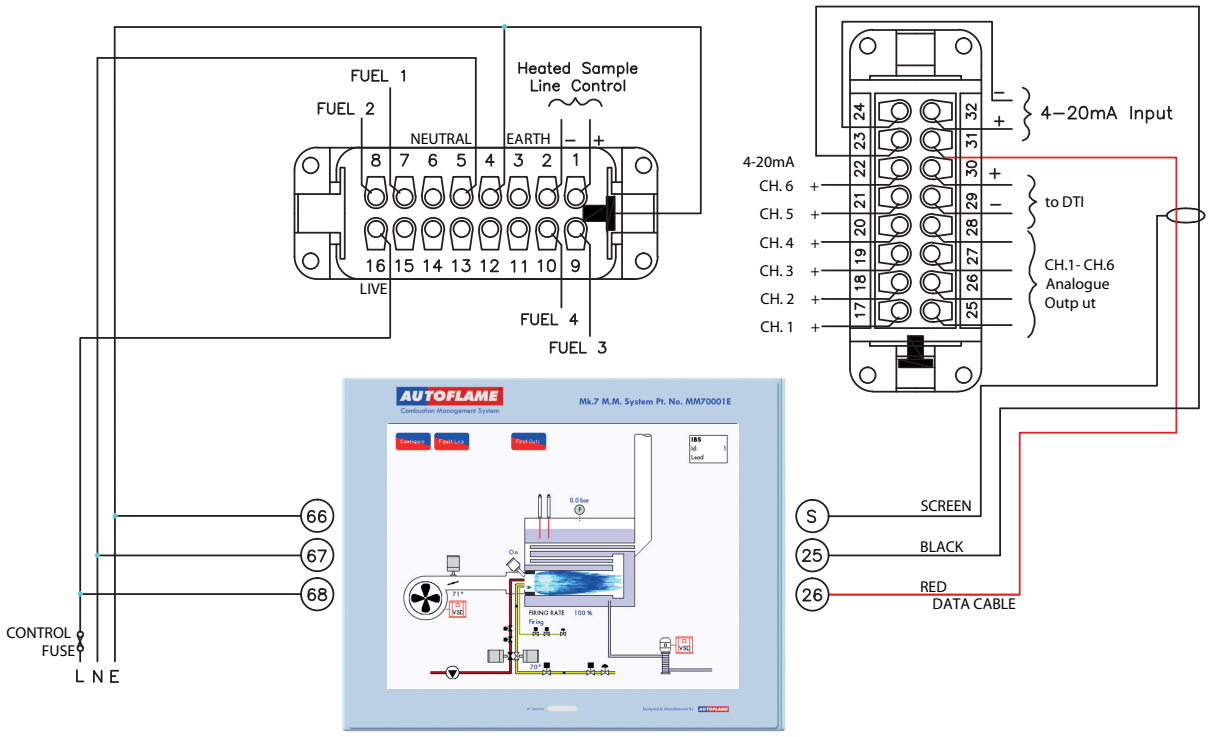
1.3 Connection Between M.M. and E.G.A.

1.3.1 Connection Between Mk7 M.M. and Mk8 E.G.A.

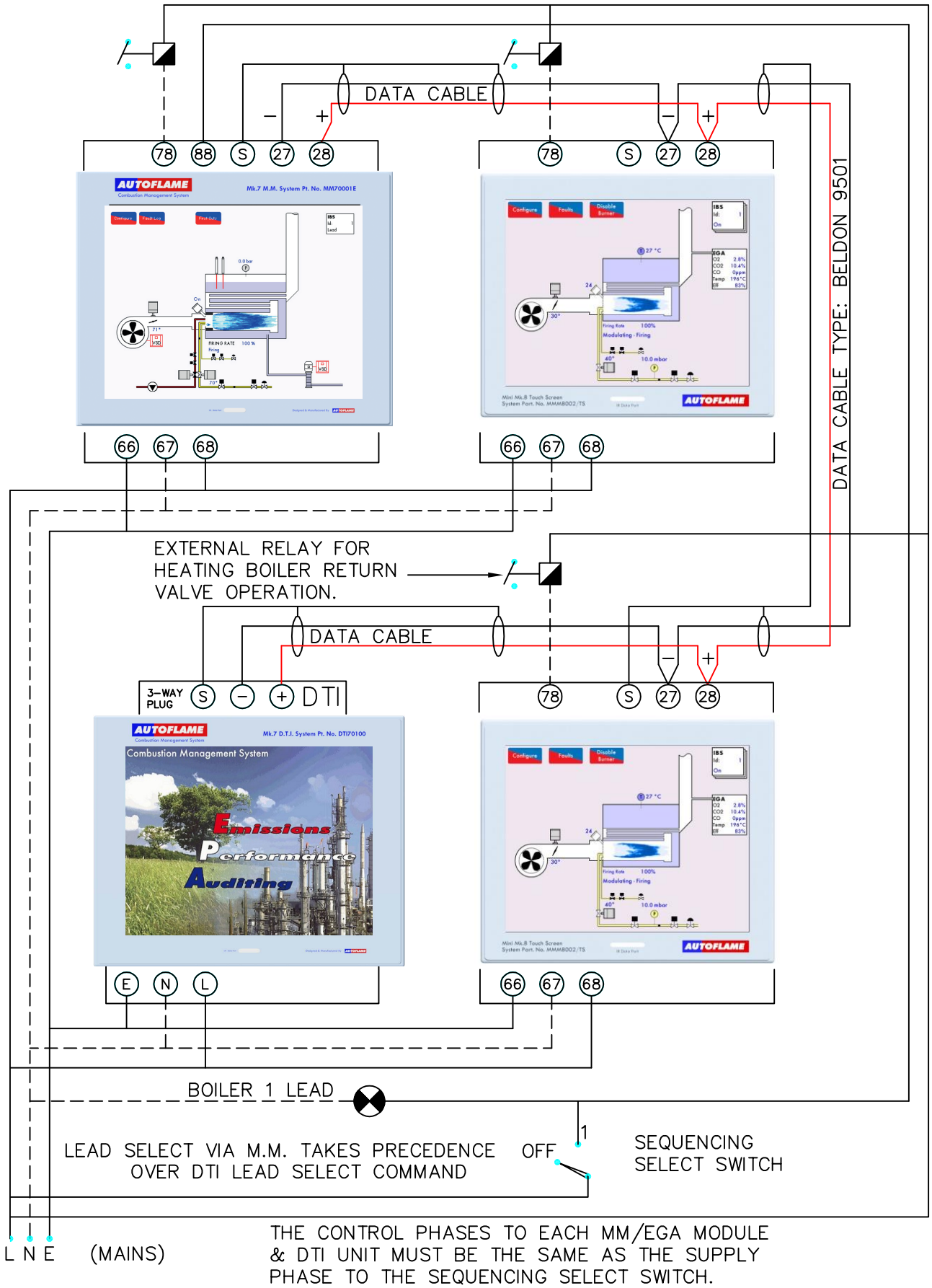


1.3.2 Connection Between Mk7 M.M. and Mk7 E.G.A.

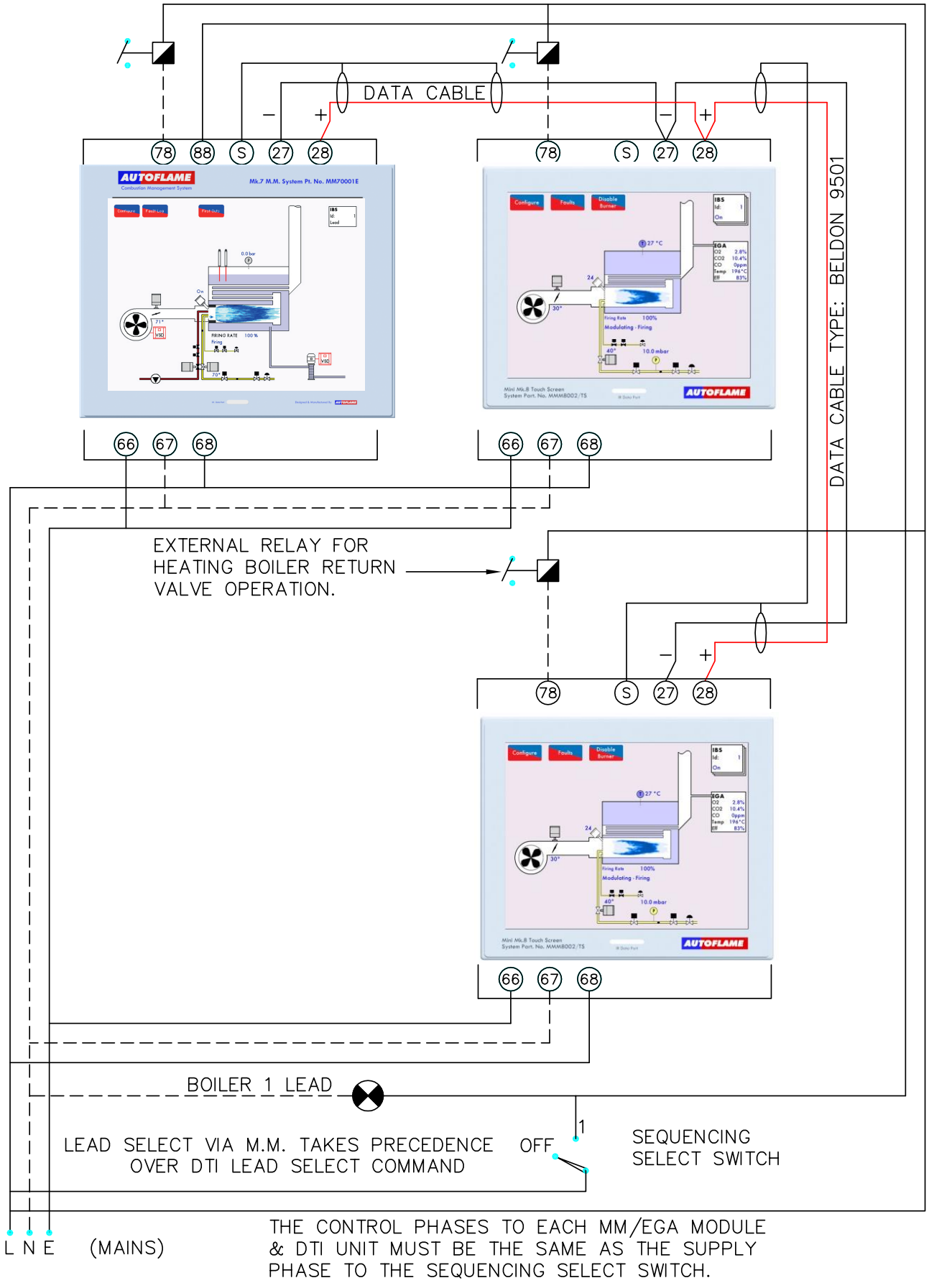




1.4 Connection Between Mk7 M.M. and Mk7 D.T.I.



1.5 Sequencing Diagram



2 OPTIONS AND PARAMETERS

2.1 Options

Note: The Options, Parameters and Expansion Options must only be changed by factory trained and certified technicians who have a thorough appreciation of the Autoflame combustion systems and the combustion process in general. Any person changing these set-ups who does not have the correct factory training and understanding of these settings/adjustments may place themselves and others in a potentially dangerous situation.

CH1, CH2, CH3, CH4, CH5, CH6 & CH7 refer to the rows of  **buttons respectively starting with CH1 at the top.**

The options, parameters and expansion options are all viewable while the M.M. is in run mode and the burner is firing; a number of options and parameters can be adjusted through Online Changes.

Through Commissioning Mode, all the options, parameters and expansion options can be adjusted according to the application.

Power up the unit. If the M.M. has already been commissioned, press 

when the system starts up. If the system is not already commissioned, the M.M. will go to commissioning mode automatically.

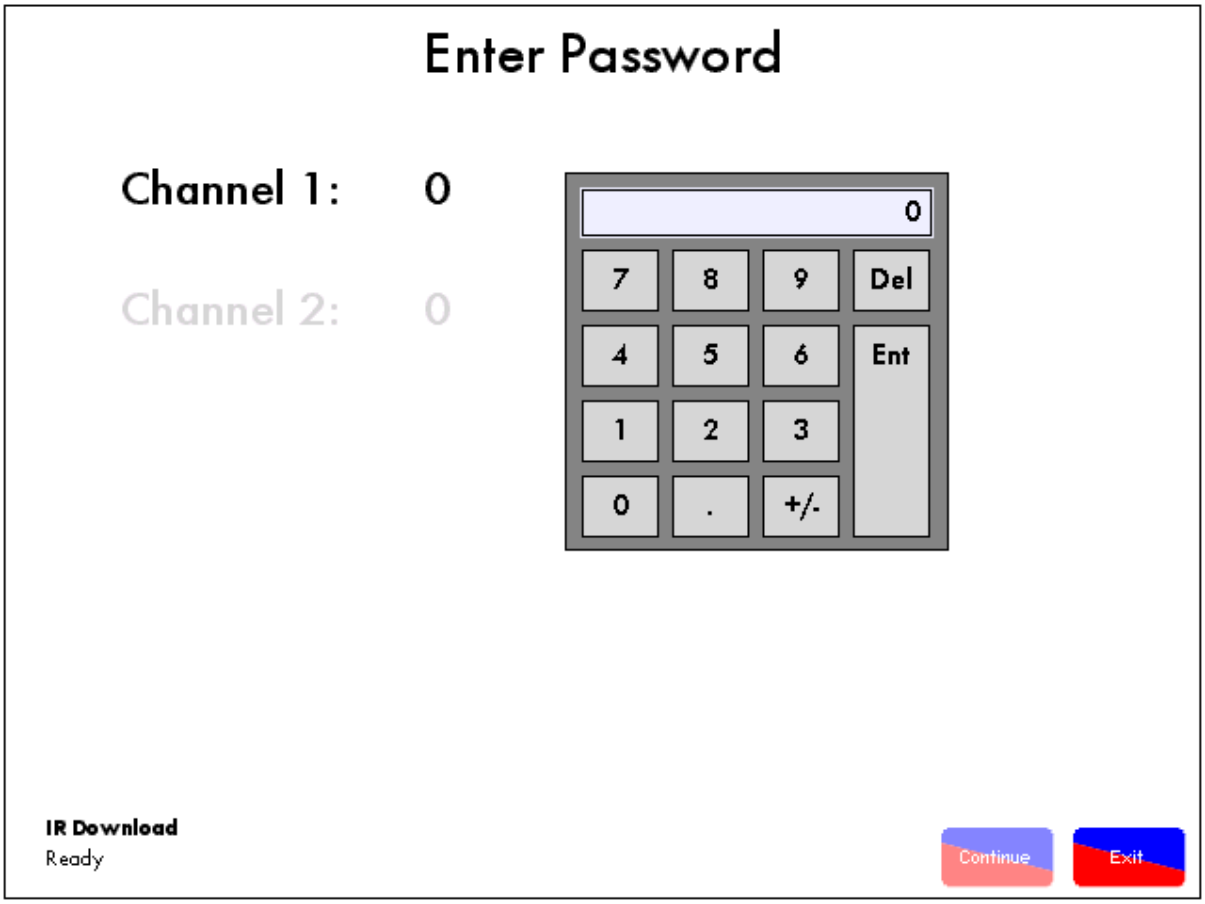


Figure 2.1.i Enter Password

"Enter Password" is displayed. Use the keypad to enter the password, then press 

to accept. Press on the Channel 1 or Channel 2 text to change the value of an incorrect entry.

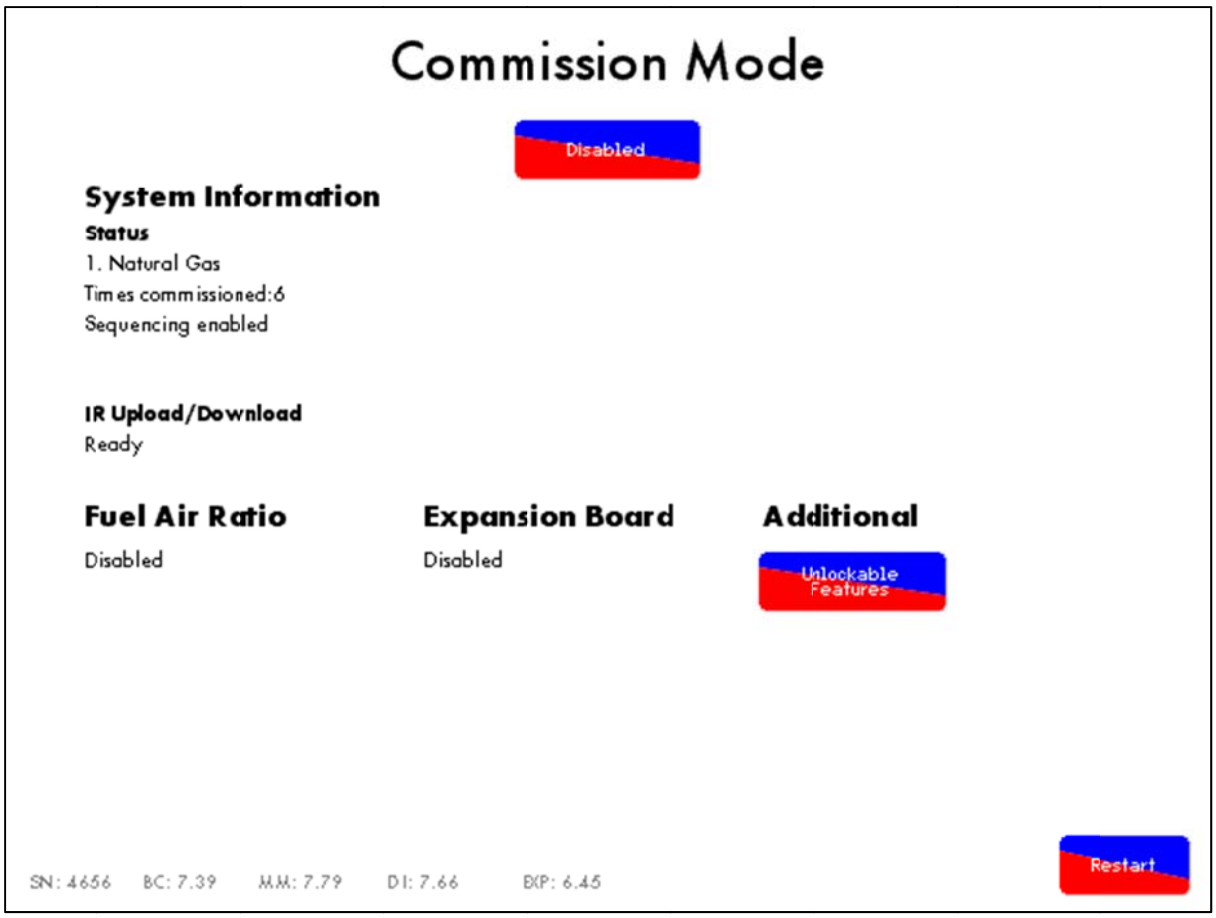


Figure 2.1.ii Commission Mode – Disabled

The "Commission Mode" screen is then entered. The M.M. will initially be disabled until commissioning data is entered or on reboot after a software upgrade.

Once the IR Upload/Download is ready, to enable the M.M. press 

and choose 'Standard' or 'Expansion Board Active,' as required.

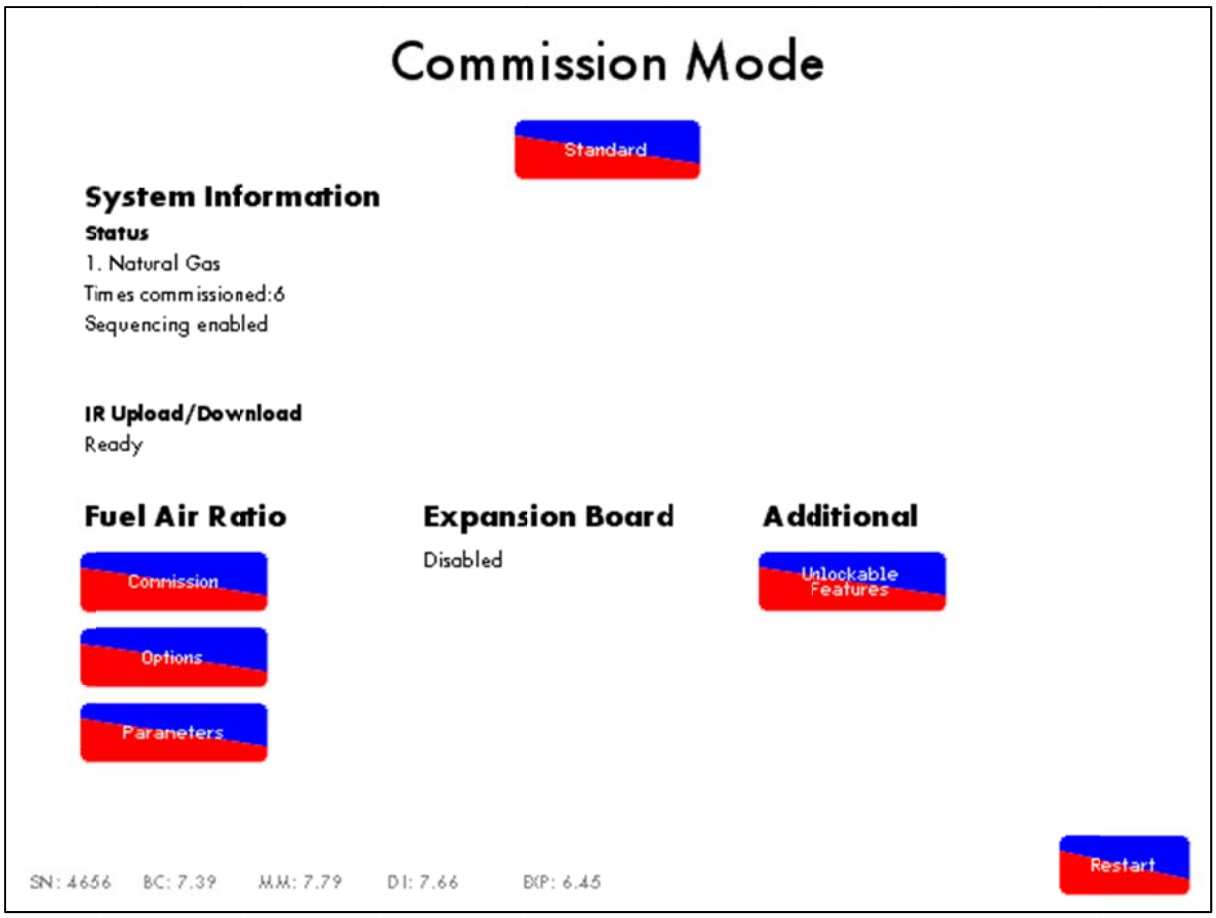


Figure 2.1.iii Commission Mode – Standard

Once activated for 'Standard' operation, all the options and parameters can be accessed and changed to the application requirements, by pressing on Options and Parameters respectively.

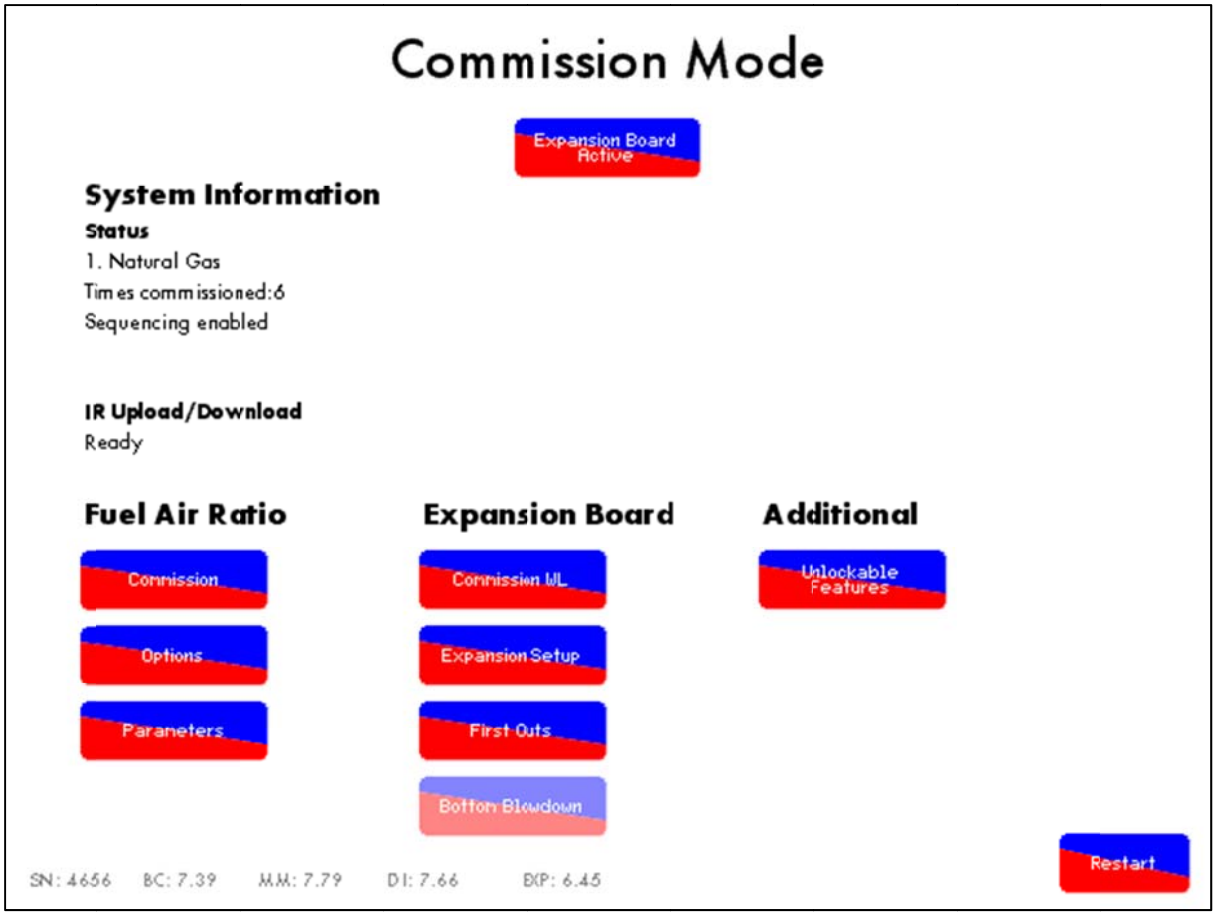


Figure 2.1.iv Commission Mode – Expansion Board Active

Once activated for 'Expansion Board Active' operation, the expansion options can be changed by pressing 

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For water level probes and draft control commissioning, first outs and bottom blowdown set-up, please refer to Mk7 Manual: Expansion Board Set-Up Guide.

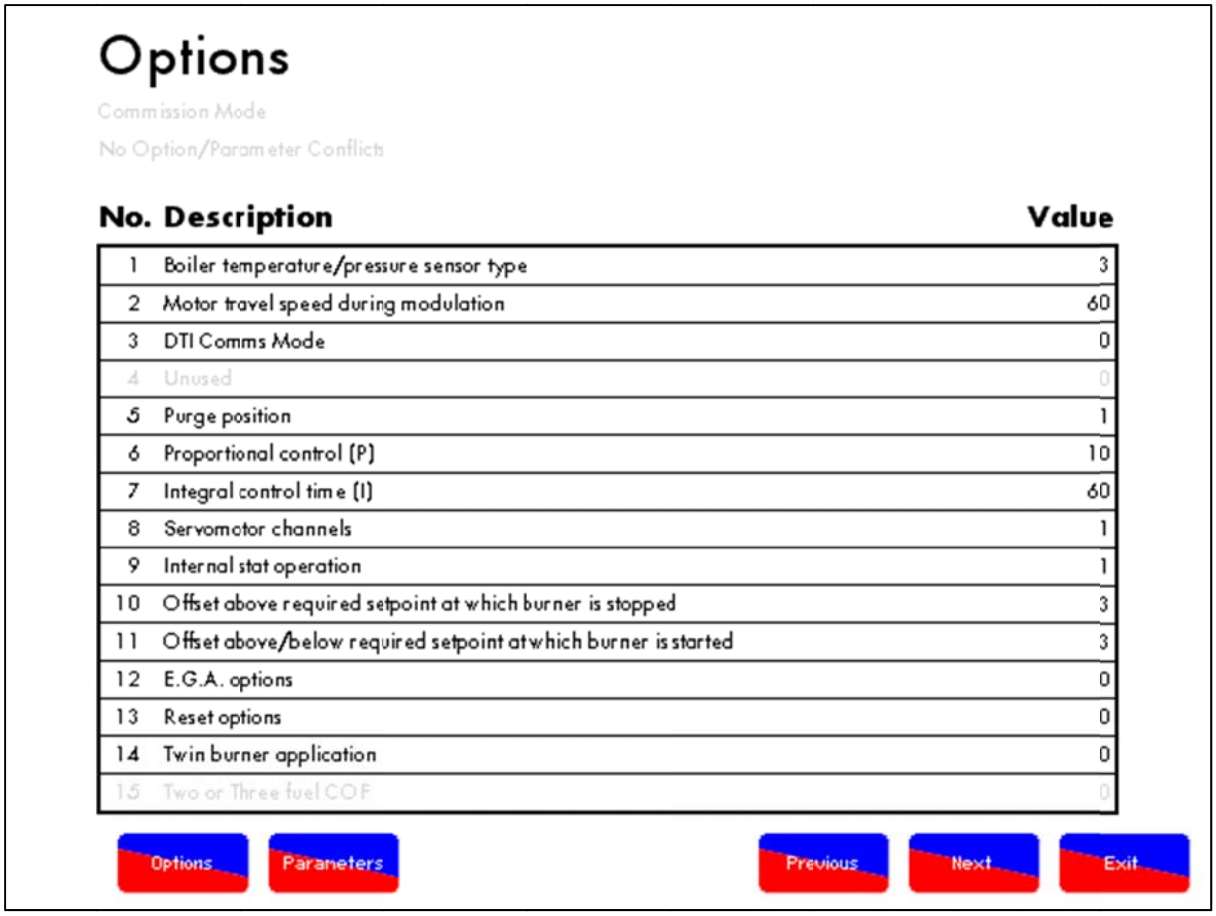
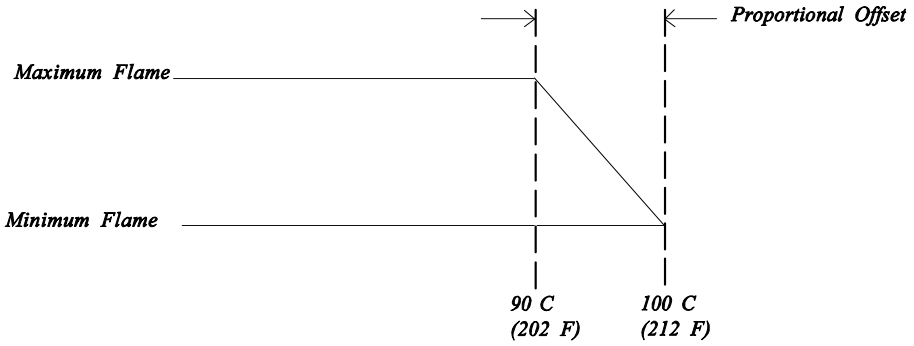
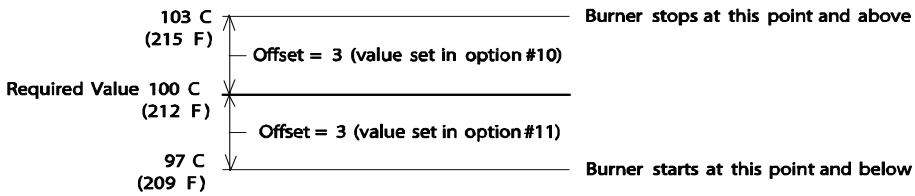
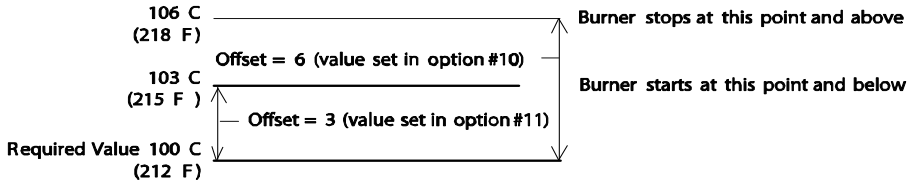


Figure 2.1.v Options

Any number of options and parameters can be changed at one time. When the changes have been made to suit the application's needs, press Save and Exit, then press restart on the Commission Mode screen.

A full list of options, parameters, and expansion options are detailed on the next page.

Option No.	Factory Setting	Option Value	Description
1	**3**		**Boiler Temperature/Pressure Sensor Type**
		3	Temperature Sensor (MM10006 & 7) 0 - 400 C (0 - 752 F)
		6	Medium Pressure Sensor (MM10008) 2.0 - 23.0 Bar (30 - 330 PSI)
		7	High Pressure Sensor (MM10009) 2.0 - 38.0 Bar (30 - 550 PSI)
		8	Low Pressure Sensor (MM10010) 0.2 - 3.80 Bar (1.5 - 55 PSI)
		10	External temperature sensor (Voltage input) - Range set by parameters 52 - 56
		11	External pressure sensor (Voltage input) - Range set by parameters 52 - 56
			Note: External load detector wired low voltage to Terminal 37 and high voltage to Terminal 38.
2	**60**		**Motor Travel Speed During Modulation:** The value is not specific to a time/distance ratio. If the speed of the motor is too fast, then increase this value. If too slow, decrease the value. At times other than modulation, the motors move at full speed or at the value set in Option 75. Movement is limited by the slowest channel, i.e. the slowest moving motor.
		5 - 240	Adjustment Range: 5 = 43 seconds from 0 degrees to 90 degrees 60 = 120 seconds from 0 degrees to 90 degrees 240 = 210 seconds from 0 degrees to 90 degrees
3	**0**		**D.T.I. Comms Mode**
		0	Mk6 D.T.I. - 9600bps
		1	Mk7 D.T.I. - 19200bps
4	**0**		**Unused.**
5	**1**		**Purge Position:** This selects the purge position. (Applicable to channels 1-4 when selected; see options 67 - 70). VSD channels 5 & 6, if optioned, purge at open position regardless of the option setting. It also applies to post purge if option 118 is set to a value greater than 0.
		0	Selected channels purge at HIGH position (high fire position)
		1	Selected channels purge at OPEN position (full span of servomotor as entered during commissioning)
6	**10**		**Proportional Control (P):** This option sets the proportional band. This is an offset below the setpoint. When the actual value reaches this point the burner will begin to modulate as it approaches the setpoint.
			Example of proportional band offset: Required setpoint = 100 C, Proportional offset = 10C (i.e. option 6 set to value 10).
			
			Proportional band: Value entered - Centigrade, Fahrenheit, Bar or PSI dependent on the type of control sensor used and display units selected - Options 1 and 65.
		5 - 2000	If Centigrade, Fahrenheit or PSI units effective.
		0.5 - 200.0	If Bar units effective.
			Note: *Decreasing this value could lead to overshooting of the required setpoint. Increasing this value may cause the burner to modulate too early, taking a longer time to reach the required setpoint.*

Option No.	Factory Setting	Option Value	Description
7	**60**		**Integral Control Time (I):** Every 'n' seconds, 10% of the present offset from setpoint value is added (below setpoint) or subtracted (above setpoint) to the present proportional value. The value of 'n' is the number of seconds set in this option. It is possible to set this option to 'off'. If 'off' is selected, there will be no integral control. Parameter 106 enables a percentage variation.
		0	Off
		1 - 250	Seconds
8	**1**		**Number of servomotor channels to be enabled:** Channel "1" is always enabled (fuel servomotor). Set Option 8 to the number of additional channels required (minimum of 1).
		1	Channels 1&2 in use.
		2	Channels 1, 2 & 3 in use.
		3	Channels 1, 2, 3 & 4 in use.
			Note: *If Option 8 is changed after commissioning then the M.M. Unit will need to be re-commissioned. unless this option is returned to its previous value.*
9	**1**		**Internal Stat Operation:** The 'internal stat' serves the purpose of turning the burner on and off according to the actual value relative to the required setpoint. There are three settings for this option. The first keeps the 'internal stat' closed all the time. In this instance, a 'working stat' must be fitted to the boiler. The second setting opens the 'internal stat' at an offset above the required setpoint and closes it at an offset below the required setpoint. The third setting opens the 'internal stat' at an offset above the required setpoint and closes it at an offset also above the required setpoint. The following diagrams illustrate this operation. The offset values are set in Options 10 and 11.
		0	Internal stat always closed.
		1	Burner starts below required setpoint.
		2	Burner starts above required setpoint.
			Option 9 = 1, e.g. using 100 C (212 F) for required setpoint.
			
			Option 9 = 2, example using 100 C (212 F). Required setpoint.
			
10	**3**		**Offset above required setpoint at which the burner is stopped:** Only relevant if option 9 is set to 1 or 2.
		2 - 1000	If Centigrade, Fahrenheit or PSI units effective
		0.2 - 100.0	If Bar units effective
11	**3**		**Offset below/above required setpoint at which the burner is started:** Only relevant if option 9 is set to 1 or 2.
		2 - 1000	If Centigrade, Fahrenheit or PSI units effective
		0.2 - 100.0	If Bar units effective

Option No.	Factory Setting	Option Value	Description
12	**0**		**E.G.A. Options:** If this option has a setting of 1 - 9, then the E.G.A. will trim and the burner must be commissioned with the E.G.A. operational. The trim is applied to channel 2 or 5, dependent on how option 76 is set.
		0	E.G.A. not optioned
		1	If an E.G.A. error occurs, then the burner will continue to fire. The servomotors will return to the original commissioned fuel/air ratio and the trim function will not be operational until the E.G.A. error is reset. No combustion/single point changes can be made whilst the E.G.A. is in an error condition. Terminal 79 is not energised in the event of an E.G.A. error.
		2	If an E.G.A. error occurs, then the burner will stop firing. The burner will not start until the E.G.A. error has been cleared and the E.G.A. is inside its operating temperature range. Terminal 79 is not energised in the event of an E.G.A. error.
		3	Same as 1, except terminal 79 is energised in the event of an E.G.A. error.
		4	Same as 2, except terminal 79 is energised in the event of an E.G.A. error
		5	Same as 1, plus the combustion limits are also tested (Options 19 - 27)
		6	Same as 2, plus the combustion limits are also tested (Options 19 - 27)
		7	System commissioned on M.M. Only - E.G.A. used only for monitoring and display purposes.
		8	Same as 5, except terminal 79 is energised in the event of an E.G.A. error.
		9	Same as 6, except terminal 79 is energised in the event of an E.G.A. error.
13	**0**	0 - 30	**Reset options to original factory settings:** To reset all of the options back to the original factory set values, set option 13 to 26.
14	**0**		**Twin Burner Application:** Twin burner operation enables two burners to run at the same time and with the same firing rate. The identification number must be set for each M.M. unit, e.g. 1 and 2.
		0	Normal single burner operation
		1	Twin burner operation for twin furnace firetube applications - both burners always fire simultaneously. If one of the burners develops a fault, then both burners shut down. Only one load detector is needed and this is connected to the odd numbered M.M. unit (the master).
		2	Twin burner operation for twin furnace watertube applications - both burners can fire simultaneously or independently. If both burners are firing they will synchronise together and fire at the same firing rate. If an error/lockout occurs on one burner then the other burner will continue to fire independently. Two load detectors are required (one for each M.M. unit).
		3	Similar to 2, with water level control on the master M.M., but will will shut down both burners in the event of an error. The expansion board must be connected to the odd numbered M.M. Both M.M.s must have the same software versions for this configuration. ***Note:*** *If communications are lost, then a yellow box will flash in the main flame screen.*
15	**0**		**Two or Three Fuel COF (only available with COF software)**
		0	Two Fuel
		1	Three Fuel
16	**0**		**Lead/Lag (IBS) and D.T.I.:** A lead boiler can be selected by connecting a line voltage to terminal 88 on the appropriate M.M. Only 1 M.M. may be selected as lead boiler at a time, or the sequencing will not operate. The lead boiler can be selected via the D.T.I. however, for this to be effective all the M.M. units on the system must have Terminal 88 volt free. Line voltage on Terminal 88 overrides the D.T.I. command.
		0	No sequencing - M.M. units still communicate and can be seen on the D.T.I.
		1	Sequencing enabled - M.M. units will respond to sequencing commands. Lead boiler is selected by a line voltage on terminal 88.
		2	Setpoint & enable/disable commands accepted from D.T.I.
		3	Both 1 and 2. ***Note:*** *Accurate fuel flow metering must be entered for sequencing to operate. A Belden 9501must be connected between each M.M. unit (see section 1.4 and 1.5 for correct connection).*
17	**0**		**NO & CO Displayed when running on oil:** If fuels 2 or 3 are selected, then the displaying of CO & NO can be on or off. This option is only relevant if an E.G.A. is operational on the system.
		0	NO & CO not displayed
		1	NO & CO is displayed normally.

Option No.	Factory Setting	Option Value	Description
18	**1**		**Carry Forward of Trim:** When the system modulates, the correction that may exist on the air damper position can be carried forward. This option is only relevant if an E.G.A. is operational on the system.
		0	No carry forward of trim.
		1	Trim carried forward.
19	**0.0**		**Upper Offset Limit % O_2:** This is an offset limit from the commisioned values. E.G.A. Limits: Options 19 - 27 are only relevant if an E.G.A. is operational on the system. Option 12 must be set to 5,6, 8 or 9 for combustion limits to be set.
		0 - 100	% O_2
20	**0.0**		**Upper Offset Limit % CO_2:** This is an offset limit from the commissioned values.
		0 - 100	% CO_2
21	**0**		**Upper Offset Limit ppm CO:** This is an offset limit from the commissioned values.
		0 - 200	ppm CO
22	**0.0**		**Lower Offset Limit % O_2:** This is an offset limit from the commissioned values.
		0 - 100	% O_2
23	**0.0**		**Lower Offset Limit % CO_2:** This is an offset limit from the commissioned values.
		0 - 100	% CO_2
24	**0**		**Unused.**
25	**0.0**		**Absolute Value % O_2:** System checks for O_2 values lower than the value specified in this option regardless of the commissioned values.
		0 - 200	% O_2
26	**0.0**		**Absolute Value % CO_2:** System checks for CO_2 values higher than the value specified in this option regardless of the commissioned values.
		0 - 200	% CO_2
27	**0**		**Absolute Value ppm CO:** System checks for CO readings higher than value specified in this option regardless of the commissioned values.
		0 - 200	ppm CO
28	**20**		**Trim Threshold:** This option is only relevant if an E.G.A. is operational on the system. The value set in this option is subtracted from the required setpoint. If the actual value is below this offset, then the E.G.A. will not trim. If the trim is to be effective at all times, then set this value to zero. This Option must also be set to zero for the E.G.A. to operate when external modulation is optioned.
		0 - 50	If Centigrade, Fahrenheit or PSI units effective.
		0 - 5.0	If Bar units effective.
			Note: *No single point changes can be made if the actual value is below the offset value.*
29	**1**		**Golden Start:** See Section 3.4.6. Parameter 15 sets the time golden start is maintained after ignition.
		0	Golden Start operates.
		1	Golden Start does not operate.
30	**50**		**D.T.I. Required Setpoint Minimum Limit:** If the system is being used with a D.T.I. maximum and minimum limits for the required setpoint must be set. If a value is received from the D.T.I. that is outside of these limits, it will be ignored and the system uses its previous required setpoint. Practical range is limited to range of sensor selected.
		5 - 9990	If Centigrade, Fahrenheit or PSI units effective.
		0.5 - 999.0	If Bar units effective.
31	**100**		**D.T.I. Required Setpoint Maximum Limit:**
		5 - 9990	If Centigrade, Fahrenheit or PSI units effective.
		0.5 - 999.0	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
32	**20**		**Trim Delay:** After ignition, the E.G.A. does not sample for the period of time set in this option (only relevant if E.G.A. is operational on system). This allows for the combustion to stabilise before sampling commences. The timing starts at the ignition point.
		0 - 250	Period (seconds) after ignition no sampling takes place.
33	**1**		**M.M. Identification:** Each M.M. withina loop must have an individual ID. Communication problems will occur within an IBS loop or in a twin burner operation if incorrect or same IDs are set for the M.M.s
		1 -10	Identification number
34	**5**		**Rating of Burner:**
		1 - 999	See Option 77 for units.
35	**10**		**Sequence Scan Time:** This is the time period between sequencing requests from the lead M.M. On the sequence scan time, the lead M.M. will demand lag burners to be brought online or offline, depending on load requirements. See Parameters 86 and 87 for change down and up thresholds.
		1 - 100	Sequence scan time (minutes).
			Note: *Accurate fuel flow metering must be entered for sequencing to operate. An data cable (Beldon 501) must be connected between each M.M. unit (see section 1.4 for correct connection).*
36	**0**		**E.G.A. Sensor Selection:** Available when using an E.G.A. System fitted with NO_2 and SO_2 cells. The following option selects the type of additional cells used.
		0	Neither
		1	NO_2 only
		2	SO_2 only
		3	NO_2 and SO_2
37	**0**		**Derivative Control Time Interval (D):** The time interval between the controller comparing the actual value and the required setpoint value. To enable derivative control this option must be set greater than 10.
		0	Off.
		1- 200	Seconds.
38	**2**		**Derivative control (D) deadband:** The deadband is the margin above and below the required setpoint in which no derivative control occurs.
		0 - 15	If Centigrade, Fahrenheit or PSI units effective.
		0 - 1.5	If Bar units effective.
39	**10**		**Derivative control (D) response sensitivity:** The sensitivity value indicates the amount of percentage firing rate increase or decrease that is inflicted by the derivative action e.g. if the chosen value was 10 then 10% firing rate would be added to the existing firing rate i.e. if the burner was firing at 50% load and the derivative action was triggered the firing rate would increase to 60%.
			The following is an example of the above control philosophy in action:
			Note: *"Control Time Interval" Set to 20 seconds* *"Deadband" Set to 2 C (37F)* *"Response Sensitivity" Set to 10%*
			Setpoint Information:
			"Required Setpoint" Set to 90 C (194 F) *"Actual Value" Reads 86 C (187 F)*
			Firing Rate Information:
			Burner firing at 50% of capacity

Option No.	Factory Setting	Option Value	Description
			In the example situation there has been 4 C (39 F) drop in temperature below the required setpoint. The deadband is set at 2 C (37 F), therefore the derivative action will be triggered as the deviation from the required setpoint is in excess of 2 C (37 F). In this example, 10% will be added to the 50% firing rate resulting in an increase in firing rate to 60% of capacity.
			The "Control Time Interval" is set for 20 seconds and if after this time interval the actual value is not within the 2 C (37 F) deviation from the required deadband, another 10% would be added to the 60% firing rate which would result in a 70% firing rate.
			By careful selection of "Control Time Interval", "Deadband" and "Response Sensitivity" an ideal response to rate of change over time can be configured. The control philosophy detailed operates inversely if the "Actual" temperature exceeds the required setpoint and is outside the "Deadband".
		1 - 100	% Sensitivity
40	**0**		**Warming Facility for Low Pressure Steam Sequencing:** For sequencing applications where check check (non-return) valves are not installed, it is not possible to use a phantom setpoint to keep the boilers in a standby warming condition. Therefore, the facility exists to install a thermostat (aquastat) in the boiler boiler shell. The thermostat will input 230V/120V on Terminal 93 and this initiates warming (see option 41). The boiler will remain in a warming state based on the settings in Options 53 and 54.
		0	Disabled
		1	Enabled
41	**0**		**2/3 State Sequencing:** This option sets 2 states of operation for the lag boilers. Either one boiler is kept in a standby warming state and the other boilers are off, or all lag boilers are kept in a standby warming state and there are no boilers offline.
		0	3 State Sequencing: LEAD, STANDBY, OFF, OFF, OFF, OFF...
		1	2 State Sequencing: LEAD, STANDBY, STANDBY, STANDBY...
42	**20**		**Warming facility for medium/high pressure steam sequencing - phantom setpoint:** For lead/lag (sequencing) applications where check (non-return) valves are installed, it is possible to use a phantom setpoint to keep the boilers in a standby warming condition. This value is an offset below the normal required setpoint. When the phantom setpoint is in effect, the burner is held at low flame.
		0 - 100	If Centigrade, Fahrenheit or PSI units effective.
		0 - 10.0	If Bar units effective.
43	**5**		**Offset above phantom setpoint when the burner stops:**
		2 - 50	If Centigrade, Fahrenheit or PSI units effective.
		0.2 - 5.0	If Bar units effective.
44	**5**		**Offset below phantom setpoint when the burner starts up:**
		2 - 50	If Centigrade, Fahrenheit or PSI units effective.
		0.2 - 5.0	If Bar units effective.
45	**0**		**External Modulation:** When enabled, the internal PID control is disabled and the firing rate is set by an external controller applied to the appropriate input Terminals 7 or 8 and 9. This input control signal can be 0 - 10V (2 - 10V), or 4 - 20mA (0 - 20mA) representing low to high fire. A manual reset high limit stat must be fitted. A working stat may be required depending on the setting of this option.
		0	Disabled.
		1	Enabled - No working stat facility (internal stat always closed - option 9), no local display of pressure/ temperature. Required setpoints not displayed. An external working stat is required.
		2	Enabled - No working stat facility (internal stat always closed - option 9), load sensor used for local display of pressure/temperature. Required setpoints not displayed. An external working stat is required.
		3	Enabled - Load sensor used for working stat facility and for local display of pressure/temperature. Required setpoints displayed. External working stat not required.
			Note: *The fuel flow metering must be entered (Option 57). If this is not entered then the M.M. will remain in the low flame hold state. Option 55 must be set to 0 if Option 45 is set to 1, 2 or 3.*
46	**0**		**Unused.**

Option No.	Factory Setting	Option Value	Description
47	**0**		**Cold Start Routine:** On burner start-up, if the actual value is at 70% or below of the required setpoint, then the burner will be held at the low flame hold position for the number of minutes set in this option. E.g. If the setpoint is 100 PSI and the actual value is less than 70 PSI, than the burner will remain at low flame for the time set in this option. When the actual value is greater than 70% (so 70 PSI for this example) the burner reverts back to normal PID control. If the burner turns off, the timer is then reset.
		0	Off.
		1 - 2000	Number of minutes for cold start operation.
			Note: *The cold start routine cannot be used with IBS and/or external modulation (Options 45 and 55).*
48	**0**		**Flue Gas Recirculation - Timer:** This is the time that the M.M. channels (servomotors/ variable speed drives) are held at the FGR start positions, after which modulation then takes place. This timer starts at the end of main flame proving. Also see Parameter 90 regarding the commissioning of the FGR positions.
		0	Disabled.
		1 - 600	Seconds.
49	**0**		**Flue Gas Recirculation - Offset:** This is an offset from the required setpoint. The M.M. channels (servomotors/variable speed drives) are held at the FGR start positions until the actual value reaches the offset value below the required setpoint.
		0 - 50	If Centigrade, Fahrenheit or PSI units effective.
		0 - 5.0	If Bar units effective.
50	**0**		**Flue Gas Recirculation - Flue Gas Temperature:** The M.M. channels (servomotors/ variable speed drives) are held at the FGR start positions until the flue gas temperature has reached 120 degC 248 degF. (An E.G.A. Must be present and optioned).
		0	Not optioned.
		1	Optioned.
51	**0**		**Unused.**
52	**0**		**Unused.**
53	**0**		**Steam Boiler Sequencing Burner 'Off' time:** The steam boiler type sequencing is enabled by setting option 1 to a respective pressure sensor. Options 42, 43 and 44 are relevant to the "standby" boiler operation. This sets how long the standby boiler is out of warming.
		0	Off
		1 - 200	Burner "Off" time (minutes) during warm up cycle. Intelligent Boiler Sequencing - Steam boiler applications.
54	**5**		**Steam Boiler Sequencing Burner 'On' time:** This sets how long the standby boiler is warming to a phantom setpoint.
		1 - 30	Burner "On" time (minutes) during warm up cycle. Intelligent Boiler Sequencing - Steam boiler applications.
55	**0**		**Internal PID/External Modulation selectable using Terminal 88:** (Cannot be used with Intelligent Boiler Sequencing)
		0	Normal Operation - Internal PID
		1	Terminal 88 = 0V - Internal PID
			Terminal 88 = Line voltage - external modulation. This option also removes the reduced setpoint from the Mk7 M.M. display if it is not a requirement.
			Note: *Option 45 must be set to zero if Option 55 set to 1. Option 9 will be used as set. If Option 9 is set to zero, the required setpoint is not displayed. The fuel flow metering must be entered (Option 57). If this is not entered, then the M.M. will remain in the low flame hold state.*
56	**1**		**Operation of alarm output for all M.M. and E.G.A. errors/lockouts on Terminal 79:**
		1	Relay normally off, on when alarm.
		2	Relay normally on, off when alarm.
			Note: *This is a switched neutral and not an output terminal.*

Option No.	Factory Setting	Option Value	Description
57	**0**		**Fuel Flow Metering:** Fuel flow metering is required for several functions to work correctly. Autoflame recommend entering 'dummy points' if a fuel meter is not available to measure the actual flow. Setting this to 1 will initiate fuel flow metering once the burner is firing.
		0	No flow metering.
		1	Flow metering operates and recalibrated.
		2	Totalised flow metering reset to zero for selected fuel.
58	**15**		**Fuel flow metering ignition delay:** Delay after ignition until fuel flow metering begins.
59	**0**		**Unused.**
60	**1**		**Hand/Auto Bumpless Transfer Operation:**
		0	When changing from Auto to Hand, servomotors go to the last known Hand position. When changing from Hand to Auto, servomotors stay in the current Hand position.
		1	When changing from Auto to Hand, servomotors stay in the current Auto position. When changing from Hand to Auto, servomotors stay in the current Hand position.
		2	As 0, but Hand position is not stored in permanent memory. (E.g. After a powerdown)
			Note: *Low Flame Hold is not a hand position. When changing from LFH to Auto, servomotors go to the last known Auto position.*
61	**1**		**Flow Metering Units: Fuel 1- Gaseous:**
		0	Cubic feet.
		1	Cubic meters.
62	**3**		**Flow Metering Units: Fuel 2 - Liquid:**
		1	Lbs.
		2	Kilograms.
		3	Litres.
		4	US Gallons.
63	**3**		**Flow Metering Units: Fuel 3 - Liquid:**
		1	Lbs.
		2	Kilograms.
		3	Litres.
		4	US Gallons.
64	**1**		**Flow Metering Units: Fuel 4 - Gaseous:**
		0	Cubic feet.
		1	Cubic meters.
65	**2**		**Type of Fuel Flow Metering:**
		0	Old fuel flow metering.
		1	Imperial fuel flow metering.
		2	Metric fuel flow metering.
66	**100**		**Firing Rate Limiter:** The value of this option is used to limit the maximum firing rate that can be attained by the system. This limit is imposed in Auto and Hand modes.
		1 - 100	Maximum firing rate permitted (%).
			Note: *Firing rate limiter is not to be used with D.T.I. load index control, external modulation or IBS.*
67	**1**		**Channel 1 Purge Position:** Options 67 to 70 set which channels 1, 2, 3 & 4 are included in the purge sequence. See Option 5 for purge position.
		0	Channel 1 to purge position.
		1	Channel 1 to remain closed for purge.
68	**0**		**Channel 2 Purge Position:**
		0	Channel 2 to purge position.
		1	Channel 2 to remain closed for purge.

Option No.	Factory Setting	Option Value	Description
69	**0**		**Channel 3 Purge Position:**
		0	Channel 3 to purge position.
		1	Channel 3 to remain closed for purge.
70	**0**		**Channel 4 Purge Position:**
		0	Channel 4 to purge position.
		1	Channel 4 to remain closed for purge.
71	**0**		**Fuel 1 - Fuel Type:**
		0	Natural Gas.
		3	Fuel 1.
72	**1**		**Fuel 2 - Fuel Type:**
		1	Light distillate oil.
		2	Heavy fuel oil.
		4	Fuel 2.
		5	Fuel 2.
73	**1**		**Fuel 3 - Fuel Type:**
		1	Light distillate oil.
		2	Heavy fuel oil.
		4	Fuel 3.
		5	Fuel 3.
74	**0**		**Fuel 4 - Fuel Type:**
		0	Natural gas.
		5	Fuel 4.
75	**0**		**Purge Motor Travel Speed:** During a purge sequence, the motor travel speed can be set independent of Option 2. This effects all selected channels.
		0 - 100	0 = Quickest time.
			100 = Slowest time.
76	**0**		**Trim channel:** If an E.G.A. is optioned, the trim can be applied to either Channel 2 (servomotor) or channel 5 (VSD). If trim on channel 5 is used, Options 91 to 97 must be entered correctly.
		0	Trim on channel 2.
		1	Trim on channel 5.
77	**0**		**Burner rating units:** Display purposes only for fuel flow metering.
		0	KW x 100 /hr
		1	Kg x 100 /hr
		2	MW /hr
		3	Btu x 100 /hr
		4	Hp x 100 /hr
		5	lbs x 100 /hr
		6	Btu x 1000 /hr
		7	Hp x 10 /hr
		8	lbs x 1000 /hr
		9	Btu x 1000 000 /hr
78	**0**		**Unused.**
79	**0**		**Lowest required setpoint:** Minimum required setpoint for OTC (see option 80 and parameter 88).
		0 - 995	If Centigrade, Fahrenheit or PSI units effective.
		0 - 99.5	If Bar units effective.

Option No.	Factory Setting	Option Value	Description
80	**0**		**Outside temperature compensation:**
		0	Disabled.
		1	Enabled using own temperature sensor.
		2	Enabled (receive only).
			Note: *A line voltage on Terminal 93 invokes a 'Night Setback' offset value, see Option 85.*
81	**140**		**Maximum boiler required setpoint at minimum outside temperature:**
		50 - 999	If Centigrade, Fahrenheit or PSI units effective.
		5.0 - 99.9	If Bar units effective.
			Note: *Range is limited in accordance with the sensor selected in Option 1.*
82	**-30**		**Minimum outside temperature:**
		- 40 +40	If Centigrade units effective.
		-40 +105	If Fahrenheit units effective.
83	**65**		**Minimum boiler required setpoint at maximum outside temperature:**
		50 - 999	Value limited in accordance with sensor selected by Option 1.
84	**30**		**Maximum outside temperature:**
		-20 +40	If Centigrade units effective.
		-40 +105	If Fahrenheit units effective.
85	**10**		**Night setback 'depression' offset value:** This offset is subtracted from the normal required setpoint and activated by a line voltage on Terminal 93.
		0 - 100	If Centigrade, Fahrenheit or PSI units effective.
		0 - 10.0	If Bar units effective.
			Note: *Only for use with an OTC sensor and Option 80 enabled.*
86	**0**		**Channel 1 softened error checking select:** Increases the positioning error from 0.1° to 0.5° for an industrial servomotor.
		0	CH1 normal small/ large servomotor.
		1	CH1 industrial positioning/softened error checking.
87	**0**		**Channel 2 softened error checking select:**
		0	CH2 normal small/large servomotor.
		1	CH2 industrial positioning/softened error checking.
88	**0**		**Channel 3 softened error checking select:**
		0	CH3 normal small/large servomotor.
		1	CH3 industrial positioning/softened error checking.
89	**0**		**Channel 4 softened error checking select:**
		0	CH4 normal small/large servomotor.
		1	CH4 industrial positioning/softened error checking.
90	**0**		**VSD operation channel 5:**
		0	Not optioned.
		1	Optioned.
91	**0**		**Output from M.M. to VSD channel 5:**
		0	Output units displayed as 4 - 20 mA
		1	Output units displayed as 0 - 10 V
		2	Output units displayed as Hz
92	**25**		**Output low speed from M.M. to VSD channel 5:** This should match the VSD low (minimum) speed.
		1 - 200	Hertz.

Option No.	Factory Setting	Option Value	Description
93	**50**		**Output high speed from M.M. to VSD channel 5:** This should match the VSD high (maximum) speed.
		1 - 200	Hertz
94	**2**		**Input signal to M.M. from VSD channel 5:**
		0	Output units displayed as 4 - 20 mA.
		1	Output units displayed as 0 - 10 V.
		2	Output units displayed as 0 - 20 mA.
95	**0**		**Input units displayed, VSD channel 5:**
		0	Selected input signal.
		1	Hertz.
96	**0**		**Input low speed to M.M. from VSD channel 5:** This should match the VSD low (minimum) speed.
		0 - 200	Hertz.
97	**50**		**Input high speed to M.M. from VSD channel 5:** This should match the VSD high (maximum) speed.
		0 - 200	Hertz.
98	**0**		**Unused.**
99	**0**		**Unused.**
100	**0**		**VSD operation channel 6:**
		0	Not optioned.
		1	Optioned.
101	**0**		**Output from M.M. to VSD channel 6:**
		0	Output units displayed as 4 - 20 mA.
		1	Output units displayed as 0 - 10 V.
		2	Output units displayed as Hz.
102	**25**		**Output low speed from M.M. to VSD channel 6:** This should match the VSD low (minimum) speed.
		1 - 200	Hertz.
103	**50**		**Output high speed from M.M. to VSD channel 6:** This should match the VSD high (maximum) speed.
		1 - 200	Hertz.
104	**2**		**Input signal to M.M. from VSD channel 6:**
		0	Output units displayed as 4 - 20 mA.
		1	Output units displayed as 0 - 10 V.
		2	Output units displayed as 0 - 20 mA.
105	**0**		**Input units displayed, VSD channel 6:**
		0	Selected input signal.
		1	Hertz.
106	**0**		**Input low speed to M.M. from VSD channel 6:** This should match the VSD low (minimum) speed.
		0 - 200	Hertz.
107	**50**		**Input high speed to M.M. from VSD channel 6:** This should match the VSD high (maximum) speed.
		0 - 200	Hertz.
108	**0**	0 - 100	**Offset above setpoint for continuous pilot shut-off (only available with BC 7.39)**
		0	Not Optioned
		1 - 100	PSI
		0.1 - 10.0	Bar
109			**Unused.**

Option No.	Factory Setting	Option Value	Description
			For safety reasons, Options, 110 - 150 also have to be entered in as Parameters. It is the responsibility of the commissioning engineer to ensure that all settings are set in accordance with the appropriate standards, local codes and practices. **in accordance with the appropriate standards, local codes and practices.** **If the M.M. system is stuck in the 'idle' condition, it is likely that options 110 - 150 are not identical to Parameters 110 - 150. If the commissioning mode is entered, the relevant Options/Parameters not set correctly will be displayed on the commissioning mode screen.**
110	**1**		**Burner flame scanner type:**
		1	Standard scanner. Internal non-permanent operation.
		2	Self check scanner. Internal permanent operation.
111	**0**		**Pilot:**
		0	Interrupted pilot. (Pilot shuts off after main flame is established).
		1	Intermittent pilot (expanding flame). (Pilot always on).
		2	No pilot
		3	Continuous pilot - interrupted pilot (only available with BC 7.39)
		4	Continuous pilot - intermittent pilot (only avaialble with BC 7.39)
112	**40**		**Pre purge time:**
		5 - 300	Seconds/minutes - see Option 135.
113	**3**		**Pre ignition time:** Time ignition transformer is on before pilot gas valve opens.
		3 - *5*	Seconds.
114	**3**		**First safety time:** Time pilot valve is open before UV is checked.
		3 - 10	Seconds.
115	**3**		**Pilot prove time - pilot trial for ignition (PTFI):**
		3 - *5*	Seconds.
116	**3**		**Fuel 1 & fuel 4 (gas) second safety time - main trial for ignition (MTFI):** Pilot/Main valve overlap. (Not Applicable to intermittent pilot - see Option 111).
		3 - 10	Seconds.
117	**5**		**Main flame proving time:** Time period from main valves open to burner modulating.
		5 - 20	Seconds.
118	**0**		**Post purge time:**
		0	No post purge.
		1 - 100	Seconds/Minutes.
			Note: *UV Not checked during post purge. See also Option 135.*
119	**10**		**Control box recycle time:** Time delay from burner shut down to startup.
		3 - 120	Seconds.
120	**10**		**UV Threshold:**
		5 - 50	Minimum flame signal strength during pilot. (All other times UV Threshold is fixed at *5*)
121	**5**		**Delay from start of pre purge after which air switch checked:**
		5 - 10	Seconds.
122	**0**		**Flame switch operation:** If this operation is enabled Terminals 85/86 are used in conjunction with a flame switch to monitor the presence of a flame.
		0	Normal UV Scanner operation.
		1	Flame switch operation.
		2	Infra Red scanner operation.
		3	Combined UV and IR.

Option No.	Factory Setting	Option Value	Description
123	**3**		**Fuel 2 & 3 (oil) second safety time - main trial for ignition (MTFI):** Pilot/main flame overlap. (Not applicable to intermittent pilot - see Option 111).
		3 - 15	Seconds.
124	**1**		**Gas valve proving pressure sensor type:**
		0	Nominal range 0 - 25" wg./0 - 65 mBar/ 0 - 1 PSI (Sensor MM 60006)
			Note: *PSI display not available with this sensor.*
		1	Nominal range 0 - 135" wg./0 - 340 mBar/ 0 - 5 PSI (Sensor MM 60008)
		2	Nominal range 0 - 300" wg./0 - 750 mBar/ 0 - 11 PSI (Sensor MM 60011)
		3	Nominal range 0 - 550" wg./0 - 1380 mBar/ 0 - 20 PSI (Sensor MM 60012)
		4	Nominal range 0 - 1650" wg./0 - 4125 mBar/ 0 - 60 PSI (Sensor MM 60014)
125	**0**		**Gas valve proving & high-low pressure limits checked - fuel 1:**
		0	Not checked on fuel 1.
		1	Gas valve proving on & high/low pressure limits checked (see Options 136/137).
		2	Do not select.
		3	Gas high/low pressure limit. If Options 136/137 are set to 0, then the online values are displayed only.
		4	External VPS optioned. It is possible within the unit to use an external VPS for this operation. If this is set then the system will wait for a mains voltage input on Terminal 55 to confirm that the external VPS operation is completed. If a voltage is not seen on Terminal 55 within 10 minutes, a lockout will occur.
126	**0**		**Oil high-low pressure limits checked - fuel 2:**
		0	Not checked on fuel 2.
		1	Do not select.
		2	Oil high/low pressure limit. If Options 139/140 are set to 0, then the online values are displayed only.
		3	Do not select.
		4	External VPS. See Option 125 for information.
127	**0**		**Oil high-low pressure limits checked - fuel 3:**
		0	Not checked on fuel 3.
		1	Do not select.
		2	Oil high/low pressure limit. If Options 139/140 are set to 0, then the online values are displayed only.
		3	Do not select.
		4	External VPS. See Option 125 for information.
128	**0**		**Gas valve proving & high-low pressure limits checked - fuel 4:**
		0	Not checked on fuel 4.
		1	Gas valve proving on & high/low pressure limits checked (see Options 136/137).
		2	Do not select.
		3	Gas high/low pressure limit. If Options 136/137 are set to 0, then the online values are displayed only.
		4	External VPS. See Option 125 for information.
129	**0**		**VPS Operation:** This Option must be set to 0 during commissioning. Once commissioning is complete it can then be set to 1 (or 2 if using BC 7.39 onwards).
		0	VPS operates before burner start up.
		1	VPS operates after burner run (low gas not checked before burner starts).
		2	VPS operates before start up and after burner run (low gas checked before burner start up, available. with BC 7.39 and onwards.
130	**2**		**Gas valve proving:**
		0	Two valve gas valve proving.
		1	Three valve gas valve proving, vent valve normally closed.
		2	Three valve gas valve proving, vent valve normally open.
		3	Two valve gas valve proving (single valve pilot).
		4	Three valve gas valve proving (single valve pilot). Vent valve normally closed.
		5	Three valve gas valve proving (single valve pilot). Vent valve normally open.
			Note: *Single valve pilot operatesmain gas valve 1 at pilot stage as CPI or external VPS will fail if used. Autoflame gas pressure sensor and internal VPS recommended.*

Option No.	Factory Setting	Option Value	Description
131	**0**		**Gas pressure units:** PSI not available for MM70006 - See Option 124
		0	"wg (inches water gauge).
		1	mbar (millibars).
		2	PSI (pounds per square inch) - units displayed to 2 decimal places.
132	**20**		**Gas valve proving time:**
		10 - 30	Seconds.
133	**5.1**		**Maximum pressure change allowed during proving time:**
		0.1 - 5	"wg/ 0.2 - 12.4 mBar/ PSI not available (Sensor MM70006)
		0.4 - 25.2	"wg/ 1.1 - 63mBar/ 0.02 - 0.91 PSI (Sensor MM70008)
		1 - 56	"wg/ 2.5 - 140mBar/ 0.04 - 2.03 PSI (Sensor MM70011)
		1.9 - 103	"wg/ 4.6 - 356 mBar/ 0.07 - 5.16 PSI (Sensor MM70012)
		5.6 - 307	"wg/ 13.9 - 765mBar/ 0.20 - 11.09 PSI (Sensor MM70014)
			Note: *See Option 124 for pressure sensor range in use, default value will change accordingly.*
134	**5**		**VPS valve opening time:**
		3 - 20	Seconds.
135	**0**		**Change purge time:**
		0	Seconds.
		1	Minutes.
		2	NFPA post purge - post purge time is set in Option 118.
			Note: *If this Option is set to 2 (NFPA post purge) then Option 118 must be set to a value of 15 or greater otherwise a lockout warning message will occur. During the NFPA post purge the servomotors will remain at the position that they were in before a normal shutdown or lockout (see also Option 67 to 70). The NFPA post purge will occur under any normal shutdown or lockout at any point in firing.*
136	**5.1**		**Gas pressure switch - offset lower limit:** This Option has two functions: 1. Static inlet pressure check - lower limit. This is checked prior to burner firing. 2. Run pressure check - lower limit. This is an offset from the commissioned value. Refer to Options 124/131.
		0.1 - 5	"wg/ 0.2 - 12.4 mBar/ PSI not available (Sensor MM70006)
		0.4 - 25.2	"wg/ 1.1 - 63mBar/ 0.02 - 0.91 PSI (Sensor MM70008)
		1 - 56	"wg/ 2.5 - 140mBar/ 0.04 - 2.03 PSI (Sensor MM70011)
		1.9 - 103	"wg/ 4.6 - 356 mBar/ 0.07 - 5.16 PSI (Sensor MM70012)
		5.6 - 307	"wg/ 13.9 - 765mBar/ 0.20 - 11.09 PSI (Sensor MM70014)
137	**5.1**		**Gas pressure switch - offset upper limit:** This works in the same way as Option 136 but checks the upper limits. This is an offset from the commissioned value. Refer to Options 124/131.
		0.1 - 5	"wg/ 0.2 - 12.4 mBar/ PSI not available (Sensor MM70006)
		0.4 - 25.2	"wg/ 1.1 - 63mBar/ 0.02 - 0.91 PSI (Sensor MM70008)
		1 - 56	"wg/ 2.5 - 140mBar/ 0.04 - 2.03 PSI (Sensor MM70011)
		1.9 - 103	"wg/ 4.6 - 356 mBar/ 0.07 - 5.16 PSI (Sensor MM70012)
		5.6 - 307	"wg/ 13.9 - 765mBar/ 0.20 - 11.09 PSI (Sensor MM70014)
138	**0**		**Oil pressure units:**
		0	Bar.
		1	PSI
139	**0.82**		**Oil pressure switch - offset lower limit:** This only checks the oil pressure lower limit during firing. This is an offset from the commissioned value.
		0	Off - lower limit not checked.
		0.8 - 4	Bar - lower limit from operating pressure.
		0 - 50	PSI - lower limit from operating pressure.

Option No.	Factory Setting	Option Value	Description
140	**0.82**		**Oil pressure switch - offset upper limit:** This only checks the oil pressure upper limit during firing. This is an offset from the commissioned value.
		0	Off - upper limit not checked.
		0.8 - 4	Bar - upper limit from operating pressure.
		0 - 50	PSI - upper limit from operating pressure.
141	**0.00**		**Purge air pressure proving:** During pre-purge this Option enables the air proving pressure to be tested at a value independent of Option 149. Option 148 must be set.
		0	Off - no purge air pressure proving.
		0 - 26.9	"wg.
		0.1 - 67	mBar.
			Note: *If Option 141 is set without Option 148 a lockout will occur when the system starts to purge. The lockout message displayed warns that Option 141 is incorrectly set.*
142	**0**		**Continuous pilot shut-off time (only available with BC 7.39 software)**
		0 - 1440	Minutes
143	**0**		**Pre purge:**
		0	Enabled.
		1	Disabled (internal VPS required before burner starts, see options 125, 128 and 129)
			Note: *Not available on fuels 2 and 3.*
144	**0**		**Unused.**
145	**0**		**Autoflame air pressure sensor:**
		0	Autoflame air pressure sensor not optioned.
		1	Autoflame air pressure sensor optioned 0 - 1 PSI. (Sensor MM70005)
		2	Autoflame air pressure sensor optioned 0 - 2 PSI. (Sensor MM70013)
146	**0**		**Air pressure units:**
		0	"wg.
		1	mBar.
147	**0.00**		**Air sensor error checking window:** Only active during modulation (error 82). The burner will shut down if outside the window.
		0	No error checking.
		0 - 5.08	"wg (maximum = +/- 3 "wg).
		0 - 12.65	mBar (maximum = +/- 7.5 mBar).
148	**0**		**Autoflame air proving selected:**
		0	Not used - Requires external air proving switch on Terminal 54 (applies to all 4 fuels).
		1	Air proving - Requires Autoflame air pressure sensor, no input on Terminal 54.
		2	Air proving - Requires Autoflame air pressure sensor and input on Terminal 54.
149	**0.39**		**Minimum air pressure proving value:** Air pressure switch function.
		0.3 - 4.99	"wg.
		0.75 - 12.42	mBar.
150	**0**		**Clear ALL commissioning data and gas/air sensor re-commission:**
		5	Clear commissioning data - Restore Options/Parameters to factory settings.
		7	Air sensor automatic re-commission (see Section 2.17.10.8).
		8	Gas sensor automatic re-commission (see Section 2.17.10.9).
			For safety reasons, Options, 110 - 150 also have to be entered in as Parameters. It is the responsibility of the commissioning engineer to ensure that all settings are set in accordance with the appropriate standards, local codes and practices e.t.c..

2.2 Parameters

Please refer to section 2.1 (options) for instructions on accessing and changing parameters.

Note: The E.G.A. related parameters have the factory default settings from years of testing on many fuels and applications. It is advised to be cautious when changing these parameters.

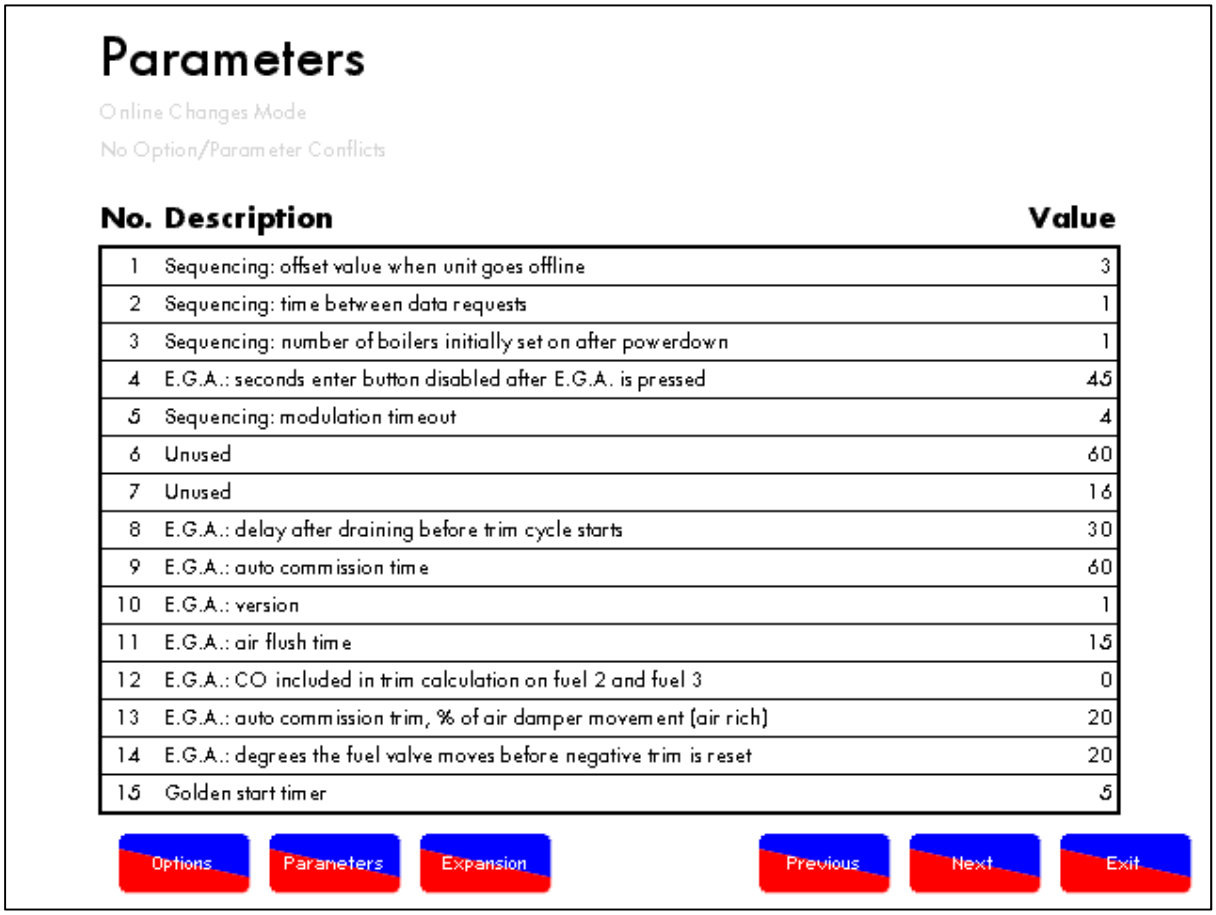


Figure 2.2.i Parameters

Parameter No.	Factory Setting	Parameter Value	Description
1	**3**		**Sequencing:** Offset value when unit goes offline. If the standby boiler fails to start the scan time will be reduced by the value set (minutes). E.g. if the scan time is set to 10 minutes and this parameter is set to 3 minutes then the next scan time will be reduced to 7 minutes when the standby boiler fails to start.
		0 - 20	Minutes.
2	**1**		**Sequencing:** Time between data requests (seconds). Bus driver requests information every 'n' seconds, M.M.s transmits every 'n' seconds, the D.T.I. only listens to transmissions.
		1 - 10	Seconds.
3	**1**		**Sequencing:** Number of boilers initally set on after powerdown.
		1 - 10	
4	**45**		**E.G.A. -** Number of seconds 'ENTER' button is disabled after 'E.G.A.' button is pressed during commissioning and single point change.
		5 - 100	Seconds.
5	**4**		**Sequencing:** Modulation time out (minutes). If the boiler is not modulating after being asked to contribute to the load after this time it is kicked out of the sequence loop e.g. burner must start to modulate within 4 minutes from being asked to contribute to the load as default.
		1 - 50	Minutes.
6	**60**		**Unused.**
7	**16**		**Unused.**
8	**30**		**E.G.A. -** Delay after draining before trim cycle starts (washout period). When the E.G.A. drainings and the cells are cleaned with air this value maintains the E.G.A. readings from before the drain period for 'n' seconds to allow the air to clear from the E.G.A.
		5 - 240	Seconds.
9	**60**		**E.G.A. -** Auto commission time (seconds). How long the air rich and fuel rich positions are held during commissioning.
		5 - 240	Seconds.
10	**1**		**E.G.A. -** Version
		0	Mk6 E.G.A.
		1	Mk7 E.G.A.
		2	Mk8 E.G.A.
11	**15**		**E.G.A. -** Air flush time, the flush out period between going air rich and fuel rich during commissioning.
		5 - 60	Seconds.
12	**0**		**E.G.A. -** CO included in trim calculation on fuel 2 & 3 (see option 17). Required when using natural gas on fuel 2 & 3.
		0	No.
		1	Yes.
13	**20**		**E.G.A. -** ÷4 = % of air damper movement. Amount of auto commission trim. Applies only to fuel rich cycle.
		5 - 30	Degrees.
14	**20**		**E.G.A. -** Number of degrees the fuel valve moves bebfore fuel rich trim is reset.
		1 - 200	Degrees
15	**5**		**Golden start timer:** Number of seconds that the servomotors are held at the golden start (choke) position. See option 29. This time starts from the ignition point.
		2 - 100	Seconds
16	**12**		**E.G.A. -** ÷2 = time between calibrations if burner does not switch off.
		1 - 50	Hours.

Parameter No.	Factory Setting	Parameter Value	Description
17	**3**		**E.G.A. -** Number of trims before an E.G.A. error is flagged when combustion limits are exceeded. Each trim is equal to Parameter 25 (seconds).
		0 - 10	Number of trims.
18	**20**		**E.G.A. -** ÷2 = % of trim amount during run. This value cannot be set above 20 (10%) or an error 25 occcurs.
		5 - 60	Amount of trim.
19	**5.00**		**E.G.A. -** ÷4 = % ofr air damper movement. Amount of auto commission trim. Applies only to air rich cycle.
		0 - 20	Air damper movement. (20 = 5.00%)
20	**0**		**Reset parameters to original factory settings**
		0 - 40	Set to 26 to reset parameters to original factory settings
21	**0**		**Unused.**
22	**0**		**Unused.**
23	**0**		**E.G.A. -** Trim to add air when CO is present. When trim is taking place, if the O_2 and CO_2 appear on the air rich side but the CO appears on the fuel rich side then the air damper will open further to remove CO.
		0	Enabled.
		1	Disabled.
24	**120**		**E.G.A. -** Calibration time.
		20 - 360	Seconds.
25	**30**		**E.G.A. -** Time between each sample (trim).
		5 - 100	Seconds.
26	**8**		**E.G.A. -** Number of samples (trims) between each trim cycle.
		1 - 50	Number of trims.
27	**25**		**E.G.A. -** Minimum operating temperature (÷5 = degC)
		0 - 255	Temperature
28	**200**		**E.G.A. -** Maximum operating temperature (÷5 = degC)
		0 - 255	
29	**0**		**Unused.**
30	**10**		**Filters load sensor readings:** Temperature and pressure detectors.
		0 - 40	0 = No filtering
31	**0**		**Selects efficiency to be displayed:**
		0	English (USA/ Canada - incorporates hydrogen & moisture loss).
		1	European.
32	**0**		**Unused.**
33	**0**		**Unused.**
34	**0**		**Unused.**
35	**2**		**O_2 change to detect residence time:** Default is set at 2 for 0.2% O_2 change to detect residence time.
		0 - 10	%
36	**5**		**Unused.**
37	**20**		**Unused.**

Parameter No.	Factory Setting	Parameter Value	Description
38	* * *		**M.M. Password:**
		0 - 255	Channel 1
39	* * *		**M.M. Password:**
		0 - 255	Channel 2
40	**10**		**Unused.**
41	**5**		**Unused.**
42	**4**		**Unused.**
43	**7**		**Unused.**
44	**4**		**O2 window inside which no trim takes place:** ÷10 = O2 %
		0 - 40	%
45	**2**		**CO2 window inside which no trim takes place:** ÷10 = CO2 %
		0 - 20	%
46	**21**		**Unused.**
47	**0**		**Unused.**
48	**0.80**		**Integral control threshold (I):** This is a percentage below the required setpoint to the proportional band offset at which point the integral control takes effect. E.g. If the required setpoint is 100 PSI, option 6 is set to 10 PSI, and parameter 48 is set to 0.8, then the integral control will take effect when the actual value is above 92 PSI. (0 = 0.80)
		0 - 99	%
49	**0**		**Required setpoint:** This is important if using parameter 72.
		0	Stored permanently in memory.
		1	Not stored permanently in memory.
50	**0**		**Unused.**
51	**0**		**Unused.**
52	**0**		**External Load Detector:** Number of decimal points, this affects parameter 53 and 55. The voltage entered in parameter 54 and 56 must be set to scale factor 10 (see table below).
		0 - 2	
53	**20**	0 - 9990	**External Load Detecor:** Maximum value (see table below)
54	**0.0**	0 - 100	**External Load Detector:** Maximum voltage (see table below)
55	**20**	0 - 9990	**External Load Detector:** Minimum value (see table below)
56	**0.0**	0 - 100	**External Load Detector:** Minimum voltage (see table below)

	Example 1: Pressure application	Example 2: Temperature application
Required/ Actual Range	0.0 – 100.0 Bar	1000 – 2000 F
Input Signal	2 – 10 Volts	1 – 6
Option 1	11	10
Option 65	2 (metric)	1 (imperial)
Parameter 52	1	0
Parameter 53	1000	2000
Parameter 54	100 (10.0V)	60 (6.0V)
Parameter 55	0	1000
Parameter 56	20 (2.0V)	10 (1.0V)

Parameter No.	Factory Setting	Parameter Value	Description
57	**0**		**Sequencing:** Highest M.M. ID. This sets the number of M.M.s in that sequencing loop for improved comms.
		0 - 10	0 = 10
58	**0**		**E.G.A. -** Air Calibrations
		0	Enabled
		1	Disabled
59	**0**		**Unused.**
60	**0**		**E.G.A. or O2 trim interface module**
		0	Normal E.G.A. operation.
		1	O2 trim interface module operation.
61	**900**		**Display backlight dim time:** Set to zero for the backlight to stay on at all times.
		0 - 999	Seconds
62	**0**		**Hot water sequencing:** If this Parameter is set to 1 then the hot water sequencing will operate in the same way as the steam sequencing (contact Autoflame before use).
		0 - 1	
63	**0**		**Reset lockout history:** Set to 1 for 2 seconds, then set back to 0 to clear lockout history.
		0 - 1	
64	**0**		**Reset totalised fuel flow metering:** Set to 1 for 2 seconds then set back to 0 to reset fuel flow metering values for all 4 fuels, for individual fuels see option 57.
		0 - 1	
65	**0**		**Reset burner history:** Set to 1 for 2 seconds, then set back to 0 to reset burner history, hours run and number of start ups.
		0 - 1	
66	**0**		**Autoflame logo**
		0 - 1	
67	**0**		**Reset bottom blowdown compensation**
		0	Disabled
		1	Reset
68	**0**		**Unused.**
69	**0**		**External modulation input range:**
		0	0 - 20mA, 0 - 10V
		1	4 - 20mA, 2 - 10V
70	**0**		**Filtering of the analogue input:** Terminals 7/8/9. The value set is the number of readings over which an average is taken. The smaller the setting the quicker the response time.
		0 - 20	0 = 5
		1	Minimum
71	**0**		**Resolution of the analogue input:** Terminals 7/8/9. The effect of resolution is to filter the noise on the input which causes hunting as the M.M. responds to a changing signal.
		0 - 20	0 = 5
		1	Minimum
72	**0**		**External required setpoint:** If this parameter is enabled, the analogue input Terminals 7/8/9 are used to set the required setpoint. Input signals can be 0 - 10 (2 - 10V) or 0 - 20 (4 - 20mA) (see parameters 69/70/71). The range of the required setpoint is set by options 30 & 31. Set parameter 49 to 1 and set option 16 to 2.
		0	Disabled
		1	Enabled

Parameter No.	Factory Setting	Parameter Value	Description
73	**0**		**Unused.**
74	**0**		**Trim method:** Changes the method of trim from the normal angular degrees trim to area trim, where the trim works on the area that is open on the damper blades to allow the air through.
		0	Angular degrees trim.
		1	Area trim (quick commission).
75	**0**		**Unused.**
76	**0**		**Unused.**
77	**0**		**Unused.**
78	**0**		**Unused.**
79	**0**		**E.G.A. Splitter for twin burner application:** When using twin burners its is possible to use the E.G.A. data from the master M.M. module for the slave M.M. module, so only one E.G.A. is required. Set parameter 79 to 1 on the slave and parameter 79 to 0 on the master.
80	**60**		**Unused.**
81	**0**		**Unused.**
82	**0**		**Unused.**
83	**0**		**Display diagnostic values**
		0	Disabled
		1	Enabled
84	**0**		**Display diagnostic values for Intelligent Boiler Sequencing**
		0	Disabled
		1	Enabled
85	**0**		**Modulation exerciser:** Repeatedly run between high and low flame. The higer the value, the longer high/low flame position is held for.
		0 - 250	Seconds
86	**0**		**Intelligent Boiler Sequencing change down threshold:** If left at 0, change down threshold is 85% .e.g. if the combined firing rate of the last 2 boilers is below this value, the last lag boiler will go into warming/off.
		0 - 99	%
87	**0**		**Intelligent Boiler Sequencing change up threshold:** If left at 0, change up threshold is 95% e.g. if the firing rate of the first last boiler online is above this value, then the next boiler will come online.
		0 - 100	%
88	**0**		**Adjust errors in the OTC sensor reading:** If the actual reading is too high set a negative value to adjust, if the reading is too low set a positive value.
		-50 - +50	1deg F or 0.5deg C
89	**0**		**Unused.**
90	**0**		**Flue gas recirculation:**
		0	Positions entered during commissioning.
		1	Positions entered after commissioning by performing single point change.
91	**0**		**Unused.**

Parameter No.	Factory Setting	Parameter Value	Description
92	**0**		**Boiler differential pressure proving:**
		0	Disabled
		1	Enabled
93	**0**		**Unused.**
94	**0**		**Upper offset limit ppm NO:** This is an offset limit from the commissioned values.
		0 - 999	ppm No
95	**0**		**Unused.**
96	**0**		**Upper offset limit exhaust temperature:** This is an offset limit from the commissioned values.
		0 - 999	deg C/ deg F
97	**0**		**Absolute limit exhaust temperature:** System checks for exhaust temperature values higher than this limit.
		0 - 999	deg C/ deg F
98	**0**		**Unused.**
99	**0**		**Unused.**
100	**0**		**Assured low fire shut off:**
		0	Not operational
		1	Burner modulates to low fire before turning off when above internal stat.
101	**0**		**Shuffle sequencing**
		0	Disabled
		1	Sequence order changed through D.T.I.
102	**0**		**Super "I" control offset:** The range can be up to 50deg C, deg F, PSI or 5 Bar.
		0	Not operational
		1	Operational
103	**0**		**Super "I" control speed of integration/time:**
		0 - 30	Seconds (1 seconds increment)
104	**0**		**Super "I" control amount of integration:**
		0 - 50	Degrees (0.1 degree increments)
105	**0**		**Super "I" control deadband:** A range of 10 would apply to 10 deg C/ deg F/ PSI or 1.0 Bar.
		0 - 10	Range (increments of 1)
106	**0**		**Integral control % (I):** Percent version
		0	0 = 10%
		1 - 25	Every 'n' seconds (set in option 7) 10% of the present offset from setpoint value is added or subtracted to the present proportional value. This enables a % variation.
107	* * *		**Online changes password:**
		0 - 255	Channel 1
108	* * *		**Online changes password:**
		0 - 255	Channel 2
109	**0**		**Advanced water level adjusters:** If set to 1, this will give advanced acess to the water level controls.
		0	Disabled
		1	Enabled
			NOTE: Parameters 110 - 150 are a repeat of their respective options. These values need to be entered as both an Option value and a Parameter value for safety reasons.

2.3 Expansion Options

To change the expansion options, the expansion board must be activated in Commission Mode. Upon activation, the expansion options can be accessed through the expansion options button.

Please refer to section 2.1 (options) for instructions on accessing and changing the expansion options.

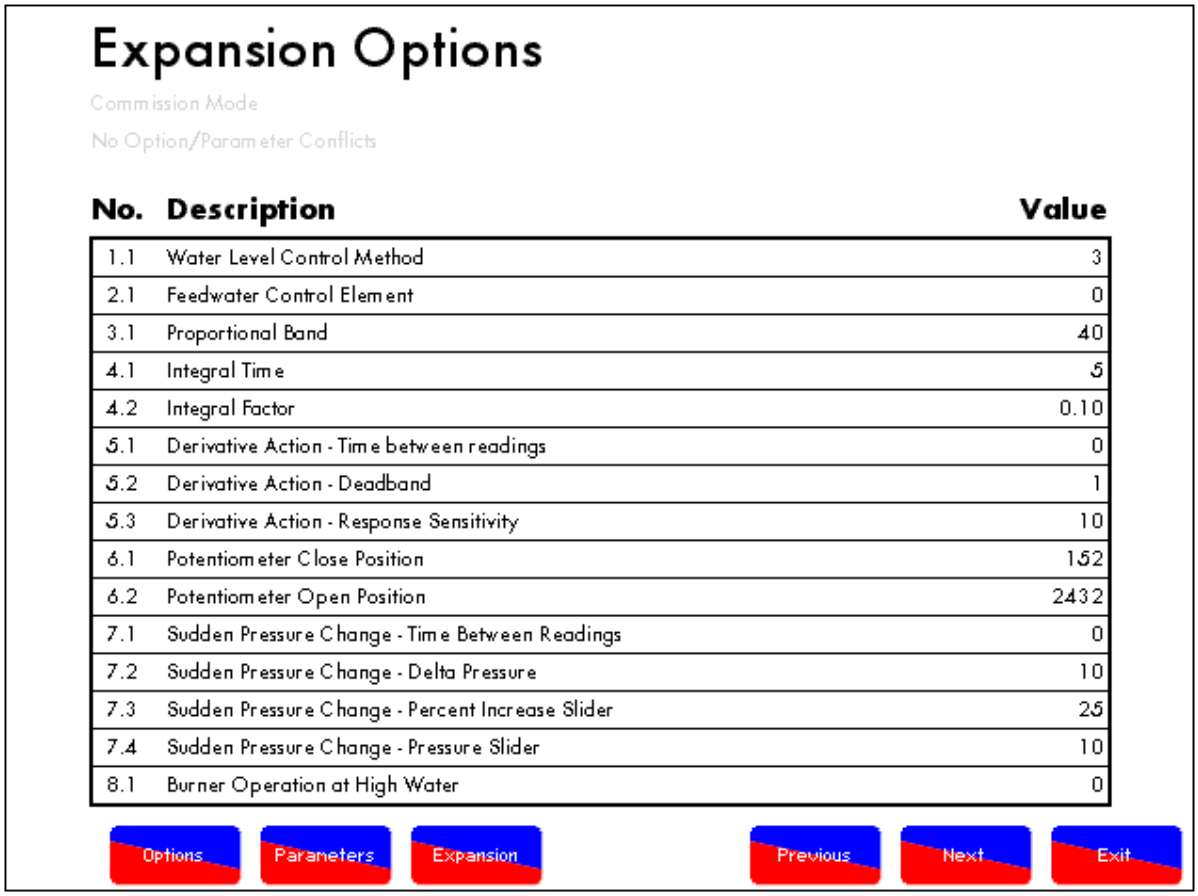
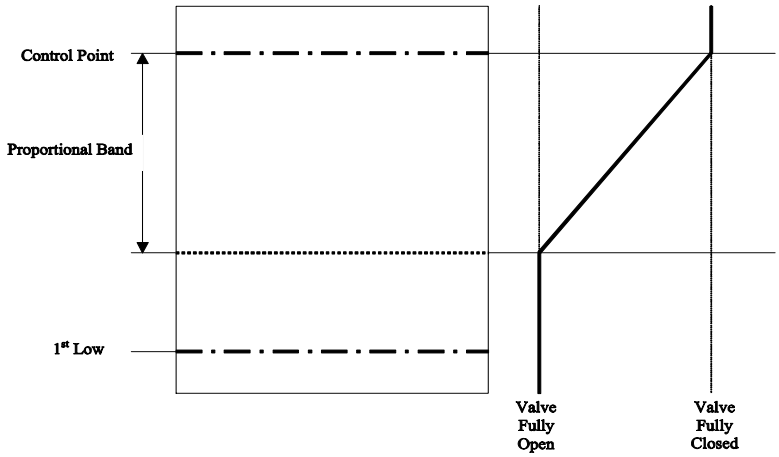


Figure 2.3.i Expansion Options

Exp. Option	Factory Setting	Value	Description
1.1	**Disabled**		**Control Type:** Configures the boiler feedwater type.
		Modulating Standard	Boiler feedwater is fitted with a motorised valve or variable speed drive capable of adjusting the feed water flow rate. This technique uses PID contrrol to position the feed water valve to match demand.
		On/ Off	Boiler feedwater has no variable flow adjustment and only provides on/off pump control through hysteresis. The "pump on" and pump off" levels to be set during commissioning. When operating, the feedwater pump will continue to remain ON until the "pump off" point is reached.
		Modulating High High	As modulating standard with additional 'High High' Water position. Boiler feedwater output turns OFF when water level reaches High High water position. Boiler feedwater turns ON when water level falls to the operating level position.
		Modulating Pre-alarms	As modulating standard with two additional pre-alarms. These include a 1st low pre-alarm and a high water pre-alarm. If the water level reaches the pre-alarm levels then the burner will continue to fire. A pulsed audible alarm will become active. The operator can mute this alarm by pressing the water level button in the Mk6 mode screen. The visual alarm will still be displayed until the fault condition has cleared when the water level reaches the operating level.
		Disabled	This option disables Autoflame water level control.
2.1	**Modulating Ball Valve**		**Feedwater control element:** Required for display purposes.
		Modulating Ball Valve	Autoflame motorised ball valve
		VSD	AC Variable Speed Drive
		General	On/Off control Valve
3.1	**50%**		**Proportional Band:** When using PID, the controller output is proportional to the error between the current water level and the required operating level. This setup represents a percentage of the total band between 1st low and the control point used to proportion the output.
		5% - 100%	
4.1	**20**		**Integral Time:** This is used to set a period of time 'n' for integral action. At these intervals a percentage (See Integral Factor) of the present offset from the control point variable is added or subtracted to the present proportional value. If configured as OFF no integral action is performed. This only applies for modulating control.
		0	OFF
		1 - 100	Seconds

Exp. Option	Factory Setting	Value	Description
4.2	**0.10**		**Integral Factor:** This sets the percentage of the present offset from the control point variable to be added or subtracted from the present proportional value. This only applies for modulation control. See also expansion options 3.1 and 4.1.
		1 - 50	% (Increments of 0.01)
5.1	**OFF**		**Derivative Time:** The controller output is proportional to the water level rate of change with derivative action. This expansion option controls the time interval between the controller comparing the current water level and the required water level points. If configured as OFF no derivative action is performed. This only applies modulating control. See also expansion options 5.2 and 5.3.
		0	OFF
		1 - 100	Seconds
5.2	**10%**		**Derivative Deadband:** This expansion option is used to configure the margin above and below the required level within which there is no derivative action. This only applies for modulating control. See also expansion options 5.1 and 5.3.
		1 - 50	%
5.3	**10%**		**Derivative Response Sensitivity:** This expansion option indicates the percentage of feedwater increase or decrease that is inflicted by the derivative action. This only applies for modulating control. See also expansion options 5.1 and 5.2.
		1 - 50	%
6.1	**152**		**Potentiometer Close Position:** Servomotor potentiometer feedback at close position. This is only required when configured for use with a motorized valve. See expansion option 6.2.
		50 - 4050	
6.2	**2432**		**Potentiometer Open Position:** Servomotor potentiometer feedback at open position. This is only required when configured for use with a motorized valve. See expansion option 6.1.
7.1	**3**		**Sudden Pressure Change - Time Between Readings:** Period of seconds over which the change of pressure is tested.
		0	OFF
		1 - 60	Seconds
7.2	**1.5**		**Sudden Pressure Change - Delta Pressure (and clear band):** Amount of pressure drop over time (specified in expansion option 7.1) that must occur for raised control point to be triggered.
		1 - 50	(Increments of 0.1)
7.3	**1**		**Sudden Pressure Change - Percent Increase Slider:** Water level control point percent increase scale. Percentage of distance between control point and High water.
		0	0%
		1	25%
		2	50%
		3	75%
7.4	**1.0**		**Sudden Pressure Drop- Pressure Slider:** Pressure scale - offset from Required value.
		5 - 100	(Increments of 0.1)
8.1	**RUNS**		**Burner Operation at High Water:** Sets whether the boiler should continue to run or stop when a high water condition exists.
		RUNS	
		STOPS	
9.1	**1.00%**		**Boiler Standing Losses:** Percentage of boiler Maximum Continuous Rating, for the purpose of steam flow metering only.
		0 - 2.00	% (Increments of 0.1)

Exp. Option	Factory Setting	Value	Description
10.1	**1.0%**		**Boiler Blow Down Losses:** Percentage of boiler Maximum Continuous Rating, for the purpose of steam flow metering only.
		0 - 10.0	% (Increments of 0.1)
10.2	**Constant**		**Boiler Blow Down Loss Calculation Method:**
		Constant	Fixed loss rate
		Proportion	Loss rate proportioned to firing rate
11.1	**30%**		**Pump Turn Off Point:** When the water level increases above the control point the pump can be set to turn off at the point selected by this expansion option. The point is the percentage distance between the working control point and high water. This only applies when modulating control type is configured.
		0 - 100	%
12.1	**Enabled**		**External Alarm Inputs:** If enabled the auxiliary mains voltage terminals for 2nd LOW, 1st LOW & HIGH WATER are brought into effect. These operate in addition to the two capacitance probes.
		Enabled	
		Disabled	
20.1	**10.0**		**Make Up Flow Range:** Only relevant if using deaerator feedwater method. Set value that represents flow at 20mA - Gallons per Minutes if Imperial Units, Litres per Second if Metric. (4mA is zero flow).
		1-9999	(Increments of 0.1)
20.2	**10.0**		**Condensate Flow Range:** Only relevant if using deaerator feedwater. Set value that represents flow at 20mA - Gallons per Minutes if Imperial Units, Litres per Second if Metric. (4mA is zero flow).
		1-9999	(Increments of 0.1)
21.1	**80 deg F** **27 deg C**		**Default Feedwater Temperature:** Feedwater temperature value used if Feedwater Temperature sensor(s) not fitted. Displayed as degF or degC according to Units set (M.M. Option 65).
		32 - 300	deg F
		0 - 149	deg C
22.1	**0**		**TB Output Function:**
		0	TDS Top Blowdown
		1	Feed water Relief - Above Switch Point
		2	Feed water Relief - Below Switch Point
		3	TDS Continuous Blowdown
		4	TDS Valve Open/Close Only
22.2	**20**		**TB Output Function - Switch Point:** (only relevant if expansion option 22.1 = 1 or 2)
		1 - 80	Feed water Relief Function - Switch Point (TB Output)
22.3	**10**		**TB Output Function - Switch Point Hysteresis:** (only relevant if expansion option 22.1 = 1 or 2) If 22.1 = 1 the TB output switches ON when the modulating value angle becomes greater than the switch point (22.2). The TB output switches OFF when the modulating value angle becomes less than the switch point minus the hysteresis amount (i.e. 22.2 minus 22.3). If 22.1 = 2 the TB output switches ON when the modulating value angle becomes less than the switch point (22.2). The TB output switches OFF when the modulating value angle becomes more than the switch point plus the hysteresis amount (i.e. 22.2 plus 22.3). In either case ensure the values entered are rational - i.e. in the case of a valve the ON/OFF points are between 1 to 89 degrees.
		1 - 50	
23.1	**Disabled**		**Top Blowdown Management Operation:** If enabled the Top BlowDown Management screen will be displayed when appropriate - see Expansion Board Set-Up Guide. Expansion Option 22.1 must be set to 0, 3 or 4 so the TB output terminal performs the Top Blow Down function, or TB and TB2 perform the TDS Continuous Blowdown.
		0	Disabled
		1	Enabled

Exp. Option	Factory Setting	Value	Description
24.1	**Type 4**		**Expansion PCB Type: (N.B. These are approximate ranges only).**
		Type 1	First issue Water Level PCB (S/N <100)
		Type 2	Second Issue Water Level PCB - includes Top Blow Down & Deaerator facilities (S/N 100 - 1000)
		Type 3	Third Issue Water Level PCB - Rev1 - 7027 (S/N 1000 - 2000)
		Type 4	Fourth Issue Expansion PCB Rev2 - 7027 (S/N >2000)
25.1	**300**		**Test time to 1st low**
		30 - 600	Seconds
25.2	**300**		**Test time to 2nd low**
		30 - 600	Seconds
26.1	**75**		**Continuous Blowdown Proportional Band:** When using PID, the controller output is proportional to the error between the current TDS level and the required operating level. This only applies when TDS Continuous Blowdown is configured.
		0 - 100	%
27.1	**600**		**Continuous Blowdown Integral Time:** This expansion option is used to set a period of time 'n' for integral action. At these intervals a percentage (See Continuous Blowdown Integral Factor) of the present offset from the TDS control point variable is added or subtracted to the present proportional value. Only applies when TDS Continuous Blowdown is configured.
		1 - 1000	Seconds
29.1	**5**		**Continuous Blowdown - Derivative time:** The controller output is proportional to the TDS level rate of change for the derivative action. This option sets the time interval between the controller comparing the current TDS level and the required TDS. Only applies when TDS Continuous Blowdown is configured.
		1 - 1000	Seconds
32.1	**152**		**Continuous Blowdown - Potentiometer Close Position:** Servo potentiometer feedback at close position. This is only required when configured for use with a motorized valve. See also expansion option 33.1.
		50 - 4050	
33.1	**2432**		**Continuous Blowdown - Potentiometer Open Position:** Servo potentiometer feedback at open position. This is only required when configured for use with a motorized valve. See also expansion option 32.1.
		50 - 4050	
36.1	**0**		**Bottom Blowdown Operation**
		0	Disabled
		1	Old Style
		2	New Style
		3	New Style with Manual Trigger
36.2	**0**		**Bottom Blowdown Reduction Enable**
		0	Disabled
		1	Enabled, Minimum Blowdown Enforced
		2	Enabled, Minimum Blowdown Not Enforced
36.3	**0**		**Minimum Bottom Blowdown Time**
		0 - 60	Seconds
36.4	**0**		**Boiler Steam Production Rating** (units are set through M.M. option 77)
		0 - 1000	
37.1	**0**		**Second Low Probe Enable/Disable**
		0	Disabled
		1	Enabled

Exp. Option	Factory Setting	Value	Description
38.1	**0**		**Temperature Sensor Configuration - Steam or Heat Flow**
		0	**Disabled:** No Sensors
		1	**Steam Flow Using Default Values:** No Sensors
		2	**Steam Flow:** T1 Feed Water Sensor
		3	**Steam Flow with Economiser:** T1 Feed Water Sensor, T1A Make Up (After Economiser), T2 Make Up (Before Economiser)
		4	**Steam Flow with Deaerator:** T1 Make Up, T1A Condensate Return
		5	**Steam Flow with Deaerator and Economiser:** T1 Make Up (After Economiser), T1A Condensate Return, T2 Make Up (Before Economiser)
		6	**Steam Flow with Deaerator and Feed Sensor:** T1 Make Up, T1A Condensate Return, T2 Deaerator Output
		7	**Heat Flow using Default Values:** No Sensors
		8	**Heat Flow:** T1 Return
		9	**Heat Flow with Economiser:** T1 Return (After Economiser), T2 Return (Before Economiser)
40.1	**0**		**Draft Control - Enable:**
		0	Disable
		1	Enable
40.2	**1**		**Draft Control - Pressure Sensor:**
		1	0 - 1 PSI Pressure Sensor MM70005
40.3	**15**		**Draft Control - Minimum Baffle Angle Limit:** The smallest angle that the stack damper will drive to during any stage of operation. This is not the closed 0.0 angular position entered during commissioning.
		0 - 45	Degrees
40.4	**5**		**Draft Control - Delay Before Compensation:** The delay after the main flame is established before draft control operation commences. This is also the time set for the deactivation window, where the M.M. must not see a change of the value set in expansion option 40.5 in this time for the PI to stop modulation, and carry forward trim operates.
		5 - 30	Seconds
40.5	**10**		**Draft Control - Firing Compensation Deactivation Window:** If the offset from the commissioned draft servomotor angle set in this option is breached over the time period set in expansion option 40.4, PI stops modulations, and carry forward trim operates.
		0 - 60	Degrees
40.6	**1**		**Draft Control - Maximum Compensation:** This is the maximum trim forwards or backwards which the stack damper can move, during trim operation. If this is set to 10%, the stack damper can move to a maximum of 10% of the commissioned draft servomotor position, backwards and forwards.
		0	10%
		1	15%
		2	20%
40.7	**0**		**Action on Pressure Sensor Failure:** This sets whether the burner will lockout or the stack damper will go to its commissioned positions along the curve, should the draft air pressure sensor fail.
		0	Lockout
		1	Revert to commissioned curve
40.8	**0**		**Pressure Tolerance Before Fault:** This is the maximum allowable pressure change from commissioned draft air pressure values over 2 minutes before an error message is displayed on the screen.
		0 - 50	PSI (0.0 - 5.0 Bar)

Exp. Option	Factory Setting	Value	Description
41.1	**200**		**Draft Control P Multiplier** The P Multiplier % is used to calculate the P Value; the P value is used together with the I Value calculated from expansion option 41.2 to give a PI Total which determines the angle the draft servomotor moves to, during trim operation. The P value is the product of the present offset from the commissioned pressure (pressure error) and the P Multiplier %. Larger P Multipliers cause a larger movment in the damper for a given pressure. Too large a P Multiplier can cause the system to overreact to small changes in the system.
		1 - 10,000	% (0.01) of Pressure Sensor Range e.g. 200 = 2.00%
41.2	**5**		**Draft Control I Multiplier** The calculated P Value (pressure error multiplied by the P Multiplier%) is multiplied by the I Multiplier % to give the I Value. This I Value is added to a running total of I Values. The amount of damper movement is controlled by the sum of the most recent P Value and the running total of I Values. The running total of I Values is updated every 'n' seconds (set in expansion option 41.3). As the pressure approaches the commissioned value the P Value becomes progressively smaller, resulting in smaller changes to the I Total.
		1 - 250	% (0.01) e.g. 5 = 5.00%
41.3	**5**		**Draft Control I Timer:** This is the time between each I value update.
		1 - 30	Seconds
41.4	**15**		**Draft Pressure Filter Time:** The draft pressure filter time filters the pressure readings over this time set this option. Increase this value to remove excessive fluctuation in draft pressure reading. Decrease this value to improve the pressure sensor's responsiveness.
		1 - 60	Seconds
42.1	**0**		**Enable TDS and Feedwater Servo Checks**
		0	Feedwater and TDS Servo checks do not operate
		1	Feedwater and TDS Servo checks operate manually

3 COMMSSIONING PROCEDURE

3.1 Introduction to Commissioning

Important Note: Prior to commissioning, the fuel and air servomotors must be calibrated to ensure that the position of the valves and damper correspond to the potentiometer feedback signal as displayed on the Mk7 M.M. When the valve is fully closed, the Mk M.M. should display zero degrees. If it does not, please adjust the servomotor potentiometer.

The commissioning procedure as described must be strictly adhered to. Anybody commissioning a Micro-Modulation system must have an adequate understanding of combustion plant. In the wrong hands hazardous conditions could be made to exist. The Autoflame products must only be installed, set up, commissioned and adjusted by an Autoflame certified technical engineer.

The fundamental idea of the system is to set a fuel valve position and then set a corresponding air damper position. Care must be taken when adjusting the fuel and air positions so as not to create any unstable or hazardous combustion conditions, e.g. moving the fuel valve to the open position without increasing the air damper position. Improper use may result in property damage, serious physical injury or death.

If the system being commissioned is an M.M. without an E.G.A. then a combustion monitor is required to check the exhaust gases. If the system does have an E.G.A., then a combustion monitor is not necessary as the E.G.A. performs all normal exhaust gas measurements. When burning oil a smoke detection device is necessary to check that the smoke generated is within limits.

Ideally to implement commissioning as quickly possible, arrange for a substantial load on the boiler. The commissioning procedure can be interrupted due to excess temperature or pressure, causing the burner to turn off. In these instances the commissioning data accumulated so far is not lost, provided power is not lost to the M.M. When the burner is called back on the system starts up automatically and commissioning can proceed from where it left off.

Once a low firing position has been established, the high fire position is entered first, then descending fuel/air positions are entered consecutively until finally a minimum fuel position is entered. The CH1 and CH2 positions must always be less than the ones previously entered. However with CH3 – CH7 it is possible to move the position above or below the previously entered point. When optioned with an expansion PCB for draft control operation, CH7 is used to enter the draft servomotor angle for desired stack pressure along the combustion curve.

3.1.1 Commissioning Procedure

On a newly installed system the following procedures should be carried out as listed:

1. Check all interconnecting wiring between the M.M. and external components is correct.
2. Set options, parameters and expansion options required (refer to sections 2.1, 2.2 and 2.3).
3. Commission bottom blowdown module if optioned.
4. Commission water level probes if optioned (refer to E.B. Set-Up Guide manual)

(If the expansion board is not optioned, omit steps 3 and 4).

5. Set up servomotors.
6. Program fuel/air positions.

On a previously commissioned system, is possible to omit steps 1 to 5.

3.2 Installation Checks

3.2.1 Commissioning Checks

When all the installation and burner adjustments are completed, the entire burner control system should be tested in accordance with the manufacturer's instructions. The procedure should verify the correct operation of:

1. Each operating control (temperature, pressure etc.)
2. Each limit switch (temperature, pressure, low water cut-off, etc.)
3. Each interlock switch (airflow switch, high and low fuel pressure or temperature switches, purge and low fire switches, fuel valve proof of closure interlock,etc.)
4. Pilot flame failure response and lockout.
5. Main flame failure response and lockout.
6. Tight shut-off for all valves

3.2.2 Operational Checks

1. Close manual main shut-off valve
2. Recheck all limit circuit wiring for proper operation and correct connection
3. Confirm that the automatic main fuel valves are wired correctly
4. Power the control and electronically check the proper sequence of operation
5. After assuring yourself that all the interlocks and valves are properly wired and that the sequence of operation is correct, open the manual main shut-off fuel valve and proceed cautiously through the boiler light off process. Check all safety interlocks for proper shutdown of the boiler

WARNING: COMMISSIONING OR BURNER START-UP MUST ONLY BE CARRIED OUT BY A FACTORY TRAINED TECHNICIAN.

3.2.3 Installation Precautions

The reliability of the equipment may be impaired if used in environments where strong electromagnetic fields exist e.g. if the equipment is installed in a boiler house where radio systems exist then additional EMC (Electro Magnetic Compatibility) measures may have to be considered.

3.2.4 Maintenance and Servicing

The Micro-Modulation unit uses solid state technology. It requires no routine maintenance.

The servomotors/gas/oil/FGR valves do require routine maintenance. Any fault associated with these parts is usually diagnosed by the M.M. Contact Autoflame for preventative maintenance procedures.

3.3 Setting Servomotors

Autoflame supply three standard sizes of servomotors – small, large and industrial, which can be used for all channels. Autoflame fuel valves require small or large servomotors only. Both small and large servomotors can be configured to drive clockwise or counter clockwise to open a valve or damper. Servomotors can be installed in any orientation; 2 fixed rotation positions if using Autoflame valves. For layout of the small, large and industrial servomotors please refer to the M.M. Valves and Servomotors Guide.

Viewing the shaft end-on, from the potentiometer end, all servomotors drive in a clockwise direction if power is applied between the LIVE and CW terminals, and counter clockwise if the power is applied between the LIVE and CCW terminal.

The operation of fuel valves and air dampers is often such that they open in a clockwise direction. If the operation needs to be reversed, it is necessary to swap various wiring connections between the M.M. and the servomotor(s). An example of reversing the operation of a fuel valve is shown in Figure 3.3.2.

Note: Servomotors are supplied by the factory set at a 0.0 position. Remember that this position may not necessarily automatically position the damper at 0.0 or a closed position. This must be physically checked. Failure to do so can result in serious injury or death.

3.3.1 Set-Up Procedure

Before a burner is fired it is essential to set up each Micro-Modulation servomotor.

A tamper proof screwdriver is required (please contact Autoflame Sales).

Usually control valves/air dampers that the servomotors drive, move through up to 90 angular degrees. The M.M. system has the ability to drive valves through 360 degrees, but the M.M. will only display from -6 to 96 degrees.

All Channel 1 to 4 and 7 readings displayed on the M.M. are in angular degrees. It is necessary to adjust the potentiometer in the servomotor assembly so that the M.M. reads 0.0 when the relevant valve/damper is at its fully closed position. The technician must physically check the mechanical position of the dampers and valves, whilst all servomotors are set to 0.0 before leaving the factory this may have changed during shipping. DO NOT ASSUME THEY HAVE BEEN PREVIOUSLY SET CORRECTLY.

To set up a servomotor, first ensure option 12 is set to 0, (this prevents E.G.A. errors from allowing continuation). Put the M.M. into the commissioning mode so that the CLOSE indicator is steady and the ENTER indicator flashes (see Section 3.4.1). By doing this it is possible to position the valve/damper mechanically by using the appropriate up and down buttons.

****WARNING****

ELECTRICAL CONNECTIONS ARE LIVE/HOT AND INCORRECT APPLICATION MAY RESULT IN SERIOUS PHYSICAL INJURY OR DEATH.

Remove the servomotor cover.

- For air servomotors carry out the following procedure:

Use the channel 2 up/down buttons on the M.M. to position the air damper to its physically closed position. Loosen the two tamper proof screws just enough to enable the potentiometer to rotate. Rotate the potentiometer clockwise or counter clockwise until the relevant channel reads 0.0. Tighten the two tamper proof screws gently until the potentiometer is secure. Do not over tighten the screws. Check that the display still reads 0.0. If incorrect repeat the adjustment process.

- For fuel servomotors carry out the following procedure:

On Autoflame gas, oil and gas/oil piggy-back valves it is necessary to remove the servomotor. Manually position the oil/gas valve slot to its closed position. Observe the position of the drive pin on the servomotor. Use the relevant channel up/down buttons to position the pin so that when the servomotor is reassembled to the valve it is in line with the slot. Reassemble the servomotor to the valve, loosen the two tamper proof screws and proceed to adjust the potentiometer position until 0.0 is displayed. Use the external position indicator to ensure the valve is in the fully closed position.

3.3.2 Servomotor Feedback Voltage

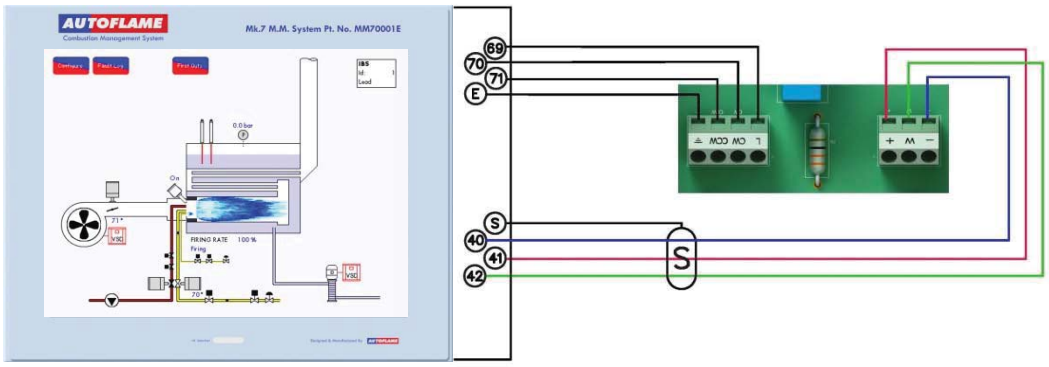
In applications where the servomotor is not positioned close to the display then it is possible to measure the feedback voltage from the servomotor in order to ensure that 0.0 degrees is displayed. By testing the DC voltage between the blue and green wires (wiper and 0V) on the servomotor low voltage terminals this will read 0.21V DC when the reading on the display is 0°. The same can be done for when the servomotor is at 96.0° where the voltage will be 3.6V.

3.3.3 Servomotors – Direction Change

MOTOR CLOCKWISE ROTATION

FIG. A

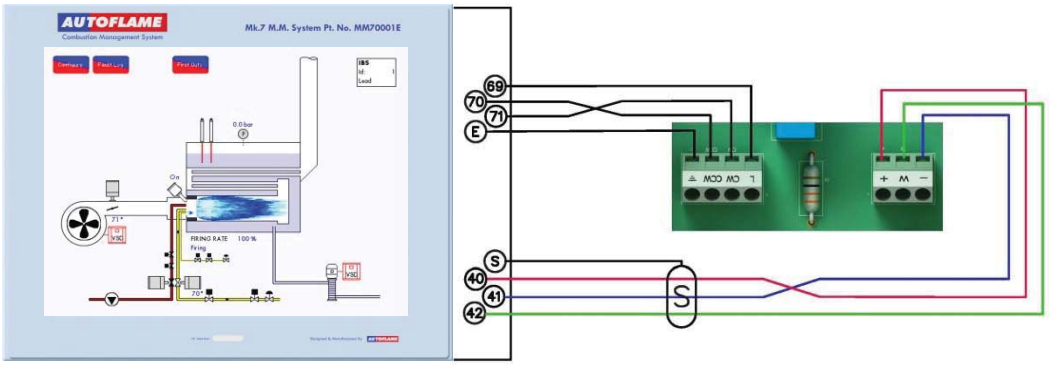
M.M. MODULE



MOTOR ANTICLOCKWISE ROTATION

FIG. B

M.M. MODULE



FOR ILLUSTRATION PURPOSES FUEL MOTOR CONNECTIONS ARE SHOWN.

3.3.4 Servomotors with Autoflame Valves

On threaded valves, the pin on the top of the valve is 90 degrees opposite from the position of the butterfly valve.

On flanged valves, the pin on the top of the valve is in line with the position of the butterfly valve.

For both valves the external visual position indicator is in line with the position of the butterfly valve. Regardless of the type of valve being used, the servomotor is dispatched from the factory with the potentiometer in the zero position. The same servomotor will be correct for both types of valve, as the servomotor for the threaded valve is mounted at 90 degrees different from the flanged valve.

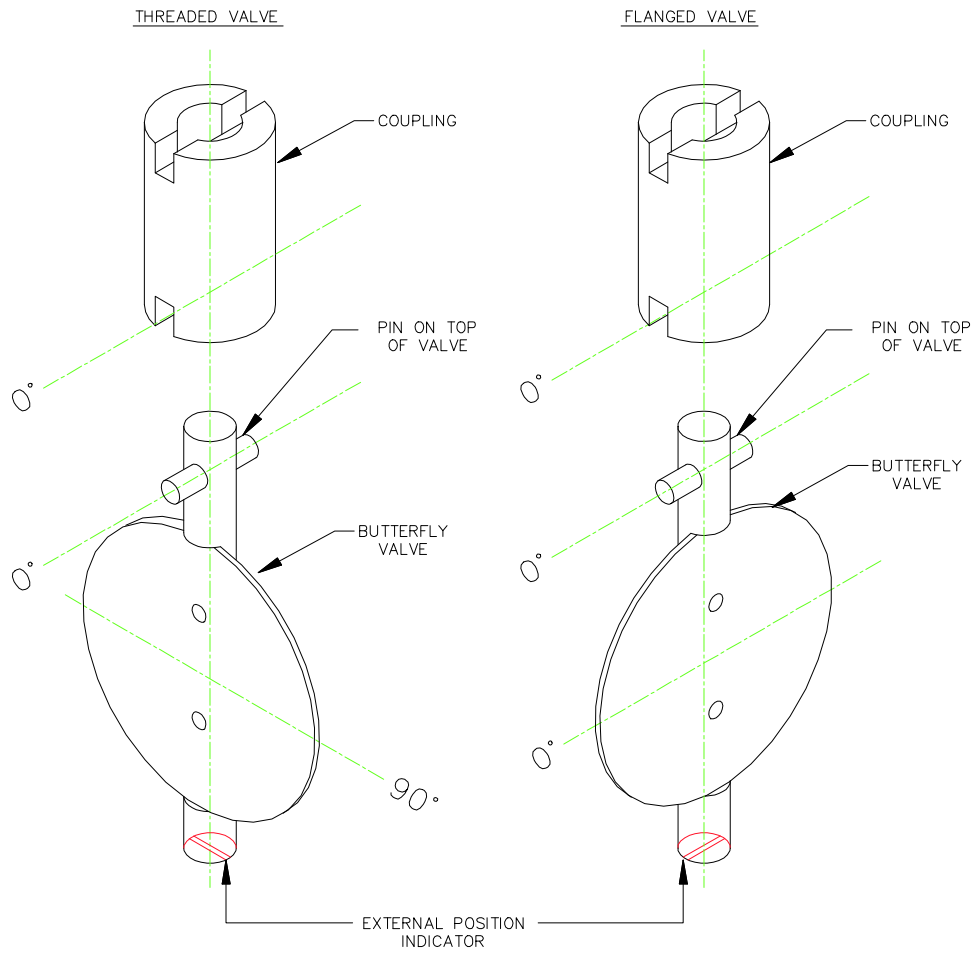


Figure 3.3.4.i Valve Pin Positions

3.4 Programming Fuel and Air Positions

During commissioning press 

to display the values of channel 1 to 7.

Press 

to display the fuel selected, actual value and required setpoint. (The required setpoint will be displayed but cannot be adjusted during commissioning. During commissioning the internal stat remains made all the time regardless of the actual value).

Note: Ensure that the high limit stat is set correctly and wired into the non-recycling interlock, as this will turn the burner off in the event that the maximum temperature or pressure is exceeded.

The OPEN and CLOSE positions are stored during commissioning. This means if a lockout occurs upon the first burner light off during commissioning there is no need to re-enter the OPEN and CLOSE positions. The burner will restart once the lockout has been reset and go straight to purge, once purge is complete you will be asked again to set the start position. However, if power is completely removed from the system then these positions are not retained in the memory and the OPEN and CLOSE positions will need to be re-entered.

If 

continues to flash with a blue dot when pressed, this indicates that the running interlock (Terminal 53) is not made, there is an E.G.A. error or the water level is not commissioned if using Autoflame water level control. Please refer to the fault finding section 4.1.

3.4.1 Programming Fuel and Air Position without E.G.A. – No Draft Control

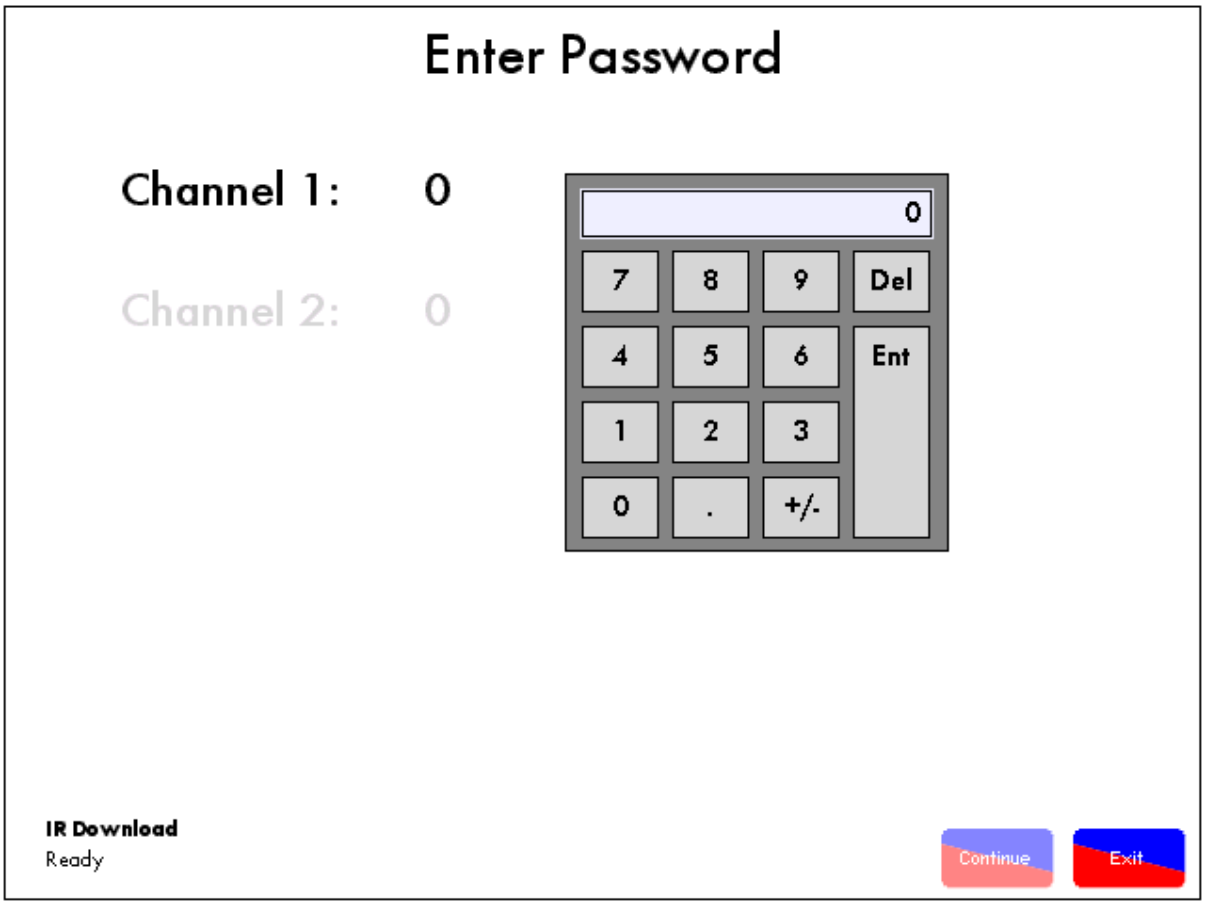


Figure 3.4.1.i Password

1. Ensure 'stat' control circuit is closed (refer to section 1.1); ensure that there is an input on terminal 53.
2. Select the fuel. The M.M. will go to the password screen.

Note: If the fuel selected is being re-commissioned, press 

on the start-up screen when it appears.

3. Use the on screen keypad to enter the Password and press Continue (3.4.1.i). If the incorrect password has been entered, simply press the 'Channel 1' or 'Channel 2' to re-enter a password. There is no need to recycle power to enter a different password.

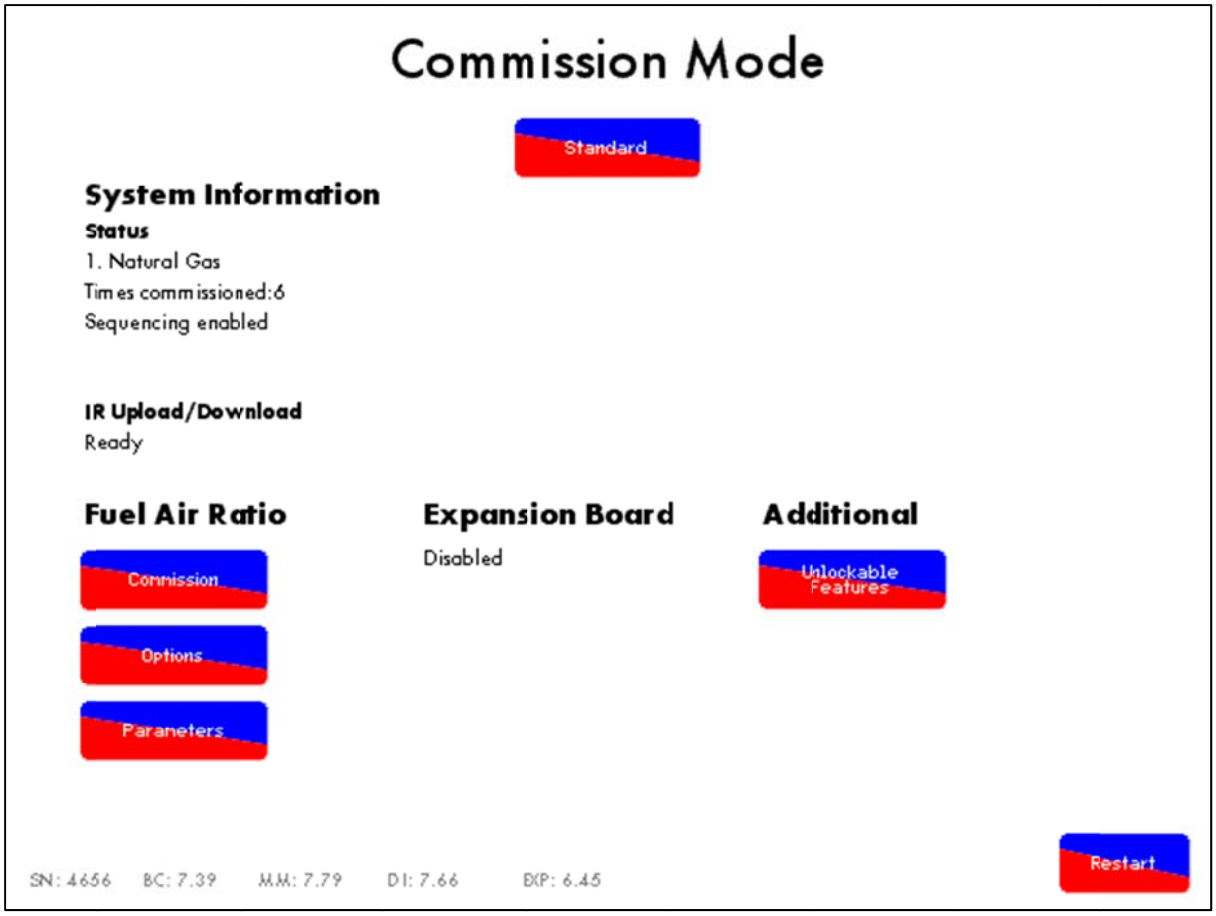


Figure 3.4.1.ii Commission Mode Main Menu

4. The Commission Mode screen will be displayed (3.4.1.ii). Please press the 

button.

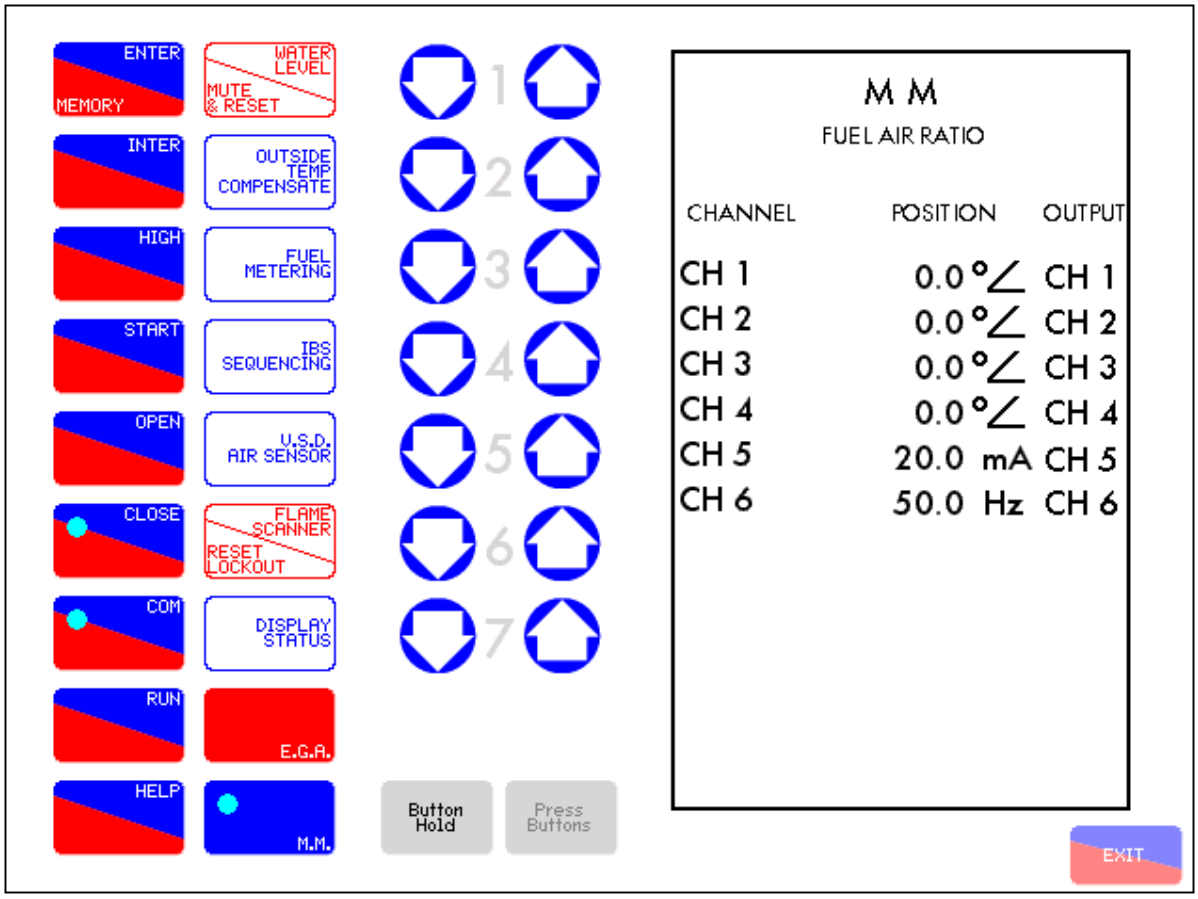
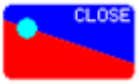


Figure 3.4.1.iii Mk6 Mode Commissioning

5. The display indicates angular position of servomotors. After the internal checks are made 

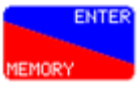
flashes with a light blue dot, press this button to enter the CLOSE position.

Note: No error checking of the servomotors is enabled at this stage. Therefore, be careful not to drive the servomotors/ dampers beyond any mechanical limitations that may be present on the damper/valve. This may cause damage to the servomotor and/or the damper/valve.

6. Use CH1 to CH7 (as optioned) 

buttons to set servomotors to 0.0°.

Note: Double check the valve/damper is physically at the 0.0 (closed) position. This can be achieved by checking for external indications on the damper assembly or the fuel valve. Remember, it is your responsibility to ensure that the servomotors are correctly calibrated. Incorrect calibration can cause serious injury or death.

Press 

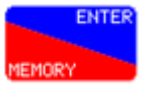
(OPEN flashes). The servomotor error checking is now enabled. If there is excess torque or a wiring issue the system will shut down and flag up an M.M. error.

7. Press 

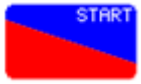
(OPEN steady, ENTER MEMORY flashes).

8. Use CH1 to CH7  buttons to set servomotors to their fully open positions. Channels 5 and 6 cannot be adjusted at this stage. Their calibration is dictated by the drive set-up and the associated Option settings.

   This is normally 90.0° for gas butterfly valves and burner air dampers, but may be set to less than 90.0° if there are mechanical stops/limits.

   Press 

(System purges, at end of purge, START flashes).

9. Press 

(START steady, ENTER MEMORY flashes).

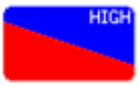
****WARNING** DO NOT ENTER START POSITION BEFORE REDUCING FUEL INPUT. THIS COULD RESULT IN A POTENTIALLY DANGEROUS SITUATION, SERIOUS PHYSICAL DAMAGE OR DEATH.**

10. Use CH1 to CH7  to set servomotors to positions where ignition can take place.

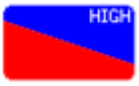
Note: Ensure that the main fuel valve is manually isolated until the pilot flame has been successfully established. Once this has been successfully established, gradually introduce the main fuel supply to the burner while observing the flame stability. Continue to introduce fuel until the manual operated main fuel isolation valve is fully open providing safe and stable combustion that can be maintained. If the combustion is not safe and stable, then adjust the fuel/air ratio accordingly. See section 3.4.5 on the Pilot Turndown feature which can be used to make adjustments to the start gas flame.

11. Press 

(Burner ignites, HIGH flashes). If a Golden Start (see section 3.4.6) or FGR (3.4.7) has been optioned then the Start may flash for a second time. The Golden Start can be ignored at this time and re-entered if necessary after the commissioning has been complete.

12. Press 

(HIGH steady, ENTER MEMORY flashes).

    Note: There is no control over the servomotors position until 

is pressed.

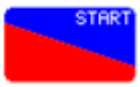
13. Use CH1 to CH7  to set maximum firing input (it is not possible to exceed the OPEN position values). Always increase the air first, followed by the fuel angular positions.

14. Press 

(INTER, or INTER and START flash).

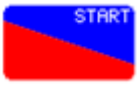
Note: Only INTER flashes if the number of INTER positions entered so far is less than or equal to three, thereafter INTER and START flash. A minimum of 3 and maximum of 15 INTER points can be entered between the HIGH FIRE and START positions.

15. Press 

or 

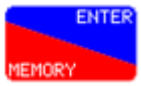
(INTER or START steady, ENTER MEMORY flashes).

    Note: There is no control over the servomotors position until 

or 

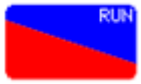
is pressed.

16. Use CH1 to CH7 
(as optioned) to reduce the positions. Always reduce the fuel first, followed by reducing the air angular position.

17. Press 

. After a short pause, RUN flashes.

If the present position is an INTER position, go back to 15, otherwise proceed further. If Start is selected the CH1 to CH7 will now need to be adjusted for the Start position. This will also be the light-off position. A Golden Start can also be added to the commissioning curve once the main commissioning curve is stored to provide more stable light-off. Please section 3.4.6.

18. Press 

to save the fuel and air positions and go to normal modulating mode. If the power is lost to the unit after pressing RUN, the commissioning curve will still be stored.

Note: If the burner has been previously commissioned then once RUN is pressed then this will overwrite the previous data for the fuel selected. Failure to hit RUN will result in the commissioning data not being stored within the unit. If this is done, a loss of power will result in a loss of data for the fuel selected.

Note: If during commissioning the burner turns off, due to the 'running interlock' opening or a lockout, it is possible to carry on commissioning from the last entered position. This is possible as long as the HIGH position has been entered, and the fuel selected is not changed. When the 'running interlock' is closed again, or the lockout is cleared, the system will purge automatically. Commissioning will then be resumed at step 9. Automatically the system bypasses the HIGH position entry and resumes the commissioning procedure from the last entered INTER position. Effectively commissioning can now be carried on from Step 14.

3.4.2 Fuel Flow Commissioning

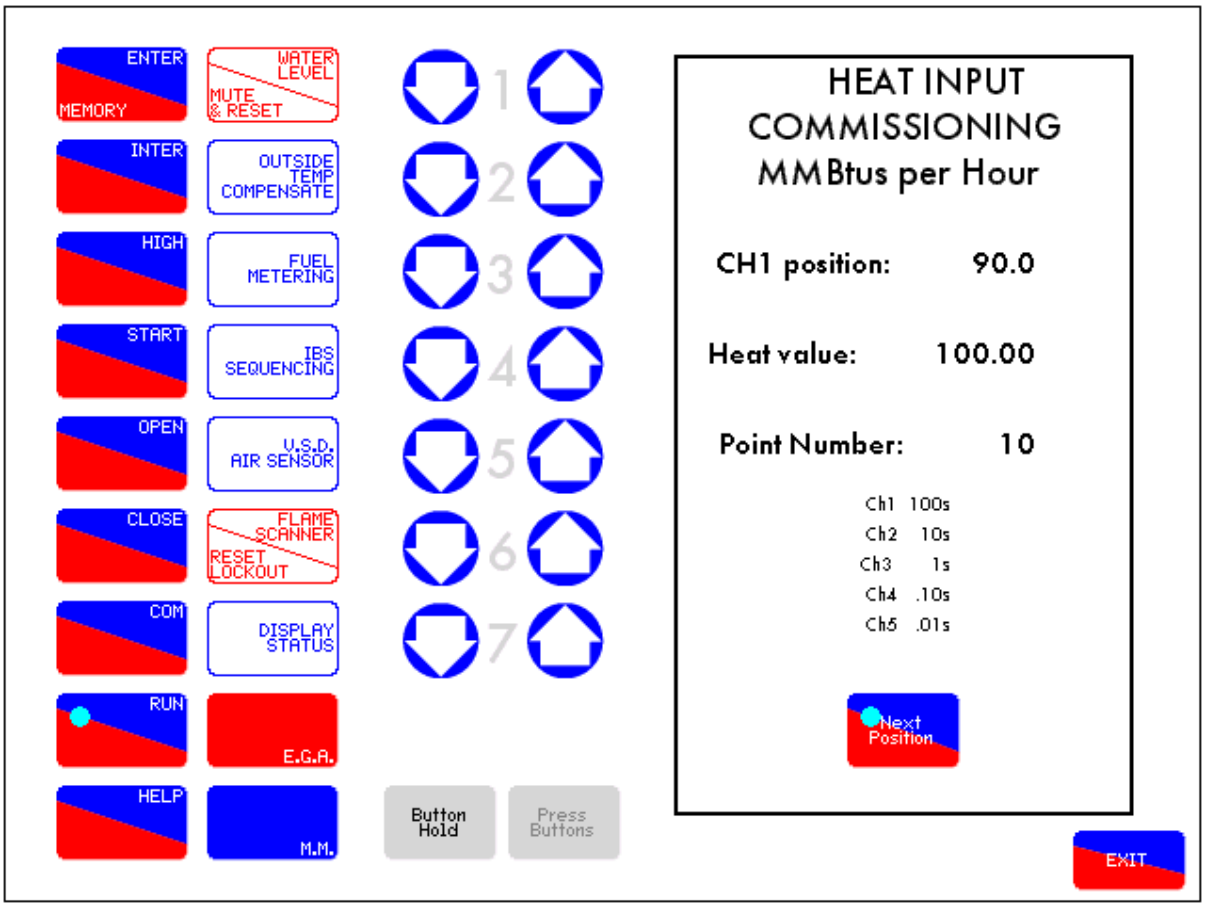


Figure 3.4.2.i Fuel Flow Commissioning

Option 57 sets fuel flow metering, if it is set to1, then immediately after the commissioning process the fuel flow commissioning screen will appear.

Fuel flow metering serves to:

- Totalise the amount of fuel used
- Calculate the firing rate and all functions that utilise firing rate information (e.g. flame graphics, IBS and steam flow metering).

Note: Fuel flow metering information MUST be set in order to allow data download from the CEMS Audit Software when using a D.T.I.

If fuel flow metering is being entered for the first time:

1. Set Option 57 to 1 in online changes or commissioning mode (If fuel flow metering is being reset then set Option 57 to 1 and press 1 again to recalibrate).

2. If in commissioning mode the unit will restart and then start burner initiation procedures. If in online changes the unit will go back to the Home Screen. Once the burner is modulating the screen in Figure 3.4.2.i will appear.

3. The display shows the fuel valve position in angular degrees and the flow units which are adjusted by using the CH1/CH2/CH3/CH4/CH5 buttons as specified at the bottom of the right box. The point number is the current point being changed.

Note: The minimum numerical value that can be entered is 0.01
The maximum numerical value that can be entered is 999.0

4. The values are entered in descending order i.e. point 10 is the high fire position and point 1 is the low fire position. The 10 points are located automatically by the M.M. along the commissioning curve.
5. Press the 

button to enter the position's Fuel Flow value.
6. Once the value is satisfactory press the 

button to confirm the value.
7. Repeat steps 5 and 6 until fuel flow data has been entered for each value.
8. Upon entering the fuel flow data for the final point (point 1) the burner will continue to fire and begin modulating.
9. To reset the totalised values for each fuel use Parameter 64.

Note: If a fuel flow meter is not being used and only arbitrary values are being used then make sure a good range of values are being used (e.g. 100 to 10 rather than 1 to 0.1). Also make sure that when using arbitrary values make sure the 10 points are in equal places along the range (e.g. 100,90,80,...,10 not 100,95,80,...,10). Not doing this could lead to problems when using IBS and the flame graphic.

Note: It is sometime required to use CH3 as the fuel channel on the M.M. usually when a burner has a gas and oil supply which is not closed coupled. In this situation CH1 is not used at all, but a dummy curve for CH1 to make the M.M. work correctly. CH1 requires a dummy curve because the M.M. still works by using CH1 as the fuel channel, so if there is not movement in the CH1 positions throughout the combustion curve, then the M.M. will reset continuously.

It is good practice when inputting a dummy curve for CH1 to put a good range of values in by splitting the range of the servomotor position equally by the number of inter-points used e.g. if you have 10 inter-points, then there should be 9 degrees between each inter-point and CH1. This will allows fuel flow metering to still work on positions of CH1, which will then allow sequencing to function correctly.

3.4.2.1 Fuel Flow – Conversion Data

Calorific Fuel Data

Stats	Kerosene SG	Gas Oil CI/SH	Light fuel Oil SG	Medium fuel Oil SG	Heavy Fuel Oil SG
Relative density 15.6°C (60°F) approx. / = litres x = kg	0.79	0.835	0.93	0.94	0.96
Flash point (closed) min °C (°F)	37.8 (100)	65.6 (150)	65.6 (150)	65.6 (150)	65.6 (150)
Viscosity kinematic (cSt) at					
15.6°C (60°F) approx.	2.0	-	-	-	-
37.8°C (100°F) approx.	-	3.0	-	-	-
82.2°C (180°F) approx.	-	-	12.5	30	70
Equivalent Redwood No.1 Viscosity at 37.8°C (100°F)	-	33 approx	250 max	1000 max	3500 max
Freezing point °C / °F	Below -40	Below -40	Below -40	Below -40	Below -40
Cloud point °C max	-	-2.2	-	-	-
Gross calorific values					
KJ/kg approx.	46,520	45,590	43,496	43,030	42,800
Btu/lb approx.	20,000	19,600	18,700	18,500	18,400
KWh/litre approx.	10.18	10.57	11.28	11.22	11.42
Therms/gallon approx.	1.58	1.64	1.75	1.74	1.77
kW/kg	-	12.66	12.08	-	11.89
Sulphur content % wt.	0.2	0.6	2.3	2.4	2.5
Water content % vol.	Negligible	0.05	0.10	0.20	0.30
Sediment content % wt	-	Negligible	0.20	0.03	0.04
Ash content % wt	-	Negligible	0.02	0.03	0.04
Mean specific heat between 0°C - 100°C approx.	0.50	0.49	0.46	0.45	0.45
Volume correction factor per 1°C	0.00083	0.00083	0.0007	0.0007	0.00068
Volume correction factor per 1°F	0.00046	0.00046	0.00039	0.00039	0.00038
Btu/U.S. gallon (US standard)	-	140,000	-	150,000	160,000
Lb/U.S. gallon (US standard)	-	7.01	-	-	7.01
% lighter than water		20%			4%
1 u.s. Gallon of oil / ft of air		1402			

Conversion Factor for Imperial Gas Flow Meters

Required Data:	Pressure of gas at meter in "wg	
	Required gas flow in ft^3/min	
Calculations:	Correction factor	= (pressure of gas at meter x 0.00228) + 0.948
	Reading on gas meter	= required gas flow / correction factor
Example:	Pressure of gas at meter	= 58" wg
	Required gas flow	= 95 ft^3/min
	Conversion factor	= (58 x 0.00228) + 0.948 = 1.08
	Reading on Meter	= 95 / 1.08 = 88 ft^3/min

Correction Factor for burners significantly above sea level. I.e. >200m (1 ft = 0.3048m)

Height above sea level in meters, Calculation for correction factor: =

(Pressure of gas at meter x 0.00228) + (0.948 – (height above sea level x 0.0001075))

Example: As above but 250 m above sea level:
Correction factor = (58x0.00228) + (0.948 – (250 x 0.0001075)) = 1.05

Gas Volume Conversion Factors - Measured conditions to standard reference

Assumed gas temperature	10 °C	50 °F
Standard pressure	e 760 mmHg	101.3612 Kpa
Standard temperature	15.56 °C	
Ambient pressure	101.325 Kpa	

Wg "	PSI	mmH2O	mmHg	Kpa	mBar	Conversion factor
1	0.036	25.4	1.867	0.249	2.49	1.0218
2	0.072	50.8	3.734	0.498	4.98	1.0243
3	0.108	76.2	5.601	0.747	7.47	1.0268
4	0.144	101.6	7.468	0.996	9.96	1.0293
5	0.181	127	9.335	1.245	12.451	1.0318
6	0.217	152.4	11.202	1.494	14.941	1.0343
7	0.253	177.8	13.069	1.743	17.431	1.0368
8	0.289	203.2	14.936	1.993	19.921	1.0393
9	0.325	228.6	16.804	2.242	22.411	1.0418
10	0.361	254	18.671	2.491	24.901	1.0443
15	0.542	381	28.006	3.736	37.352	1.0569
20	0.722	508	37.341	4.981	49.802	1.0694
25	0.903	635	46.677	6.227	62.253	1.0819
30	1.083	762	56.012	7.472	74.703	1.0944
35	1.264	889	65.347	8.717	87.154	1.107
40	1.444	1016	74.682	9.963	99.604	1.1195
45	1.625	1143	84.018	11.208	112.055	1.132
50	1.805	1270	93.353	12.453	124.505	1.1445
55	1.986	1397	102.688	13.699	136.956	1.1571
60	2.166	1524	112.024	14.944	149.406	1.1696
65	2.347	1651	121.359	16.189	161.857	1.1821
70	2.527	1778	130.694	17.435	174.307	1.1947
75	2.708	1905	140.03	18.68	186.758	1.2072
80	2.889	2032	149.365	19.925	199.208	1.2197
85	3.069	2159	158.7	21.171	211.659	1.2322
90	3.25	2286	168.035	22.416	224.109	1.2448
95	3.43	2413	177.371	23.661	236.56	1.2573
100	3.611	2540	186.706	24.907	249.01	1.2698
110	3.972	2794	205.377	27.397	273.911	1.2949
120	4.333	3048	224.047	29.888	298.812	1.3199
130	4.694	3302	242.718	32.379	323.713	1.345
140	5.055	3556	261.388	34.869	348.614	1.37
150	5.416	3810	280.059	37.36	373.515	1.3951
160	5.777	4064	298.73	39.851	398.416	1.4201
170	6.138	4318	317.4	42.341	423.317	1.4452
180	6.499	4572	336.071	44.832	448.218	1.4703
190	6.86	4826	354.741	47.323	473.119	1.4953
200	7.221	5080	373.412	49.813	498.02	1.5204

How to use this information:-

1. Measure Volumetric flow of gas for 1min in ft3 (i.e. ft3/min). Note 1m3 = 35.31ft3

2. Multiply this volume flow by 60 to give volumetric flow per hour (i.e. ft3/hr).

3. Measure the pressure of the gas supply.

4. Use the table above to obtain a conversion factor.

5. Multiply the volume flow per hour by the conversion factor to obtain a volume at reference conditions.

6. For natural gas, the calorific value is typically 1000 Btu/ft3. To obtain the firing rate of the boiler at standard reference conditions multiply the volume at reference conditions by 1000.

Represented as an equation:-
Firing rate = (Measured Volumetric flow per minute x 60 x Conversion factor x 1000) Btu/hr

3.4.3 Programming Fuel and Air Position with E.G.A. – No Draft Control

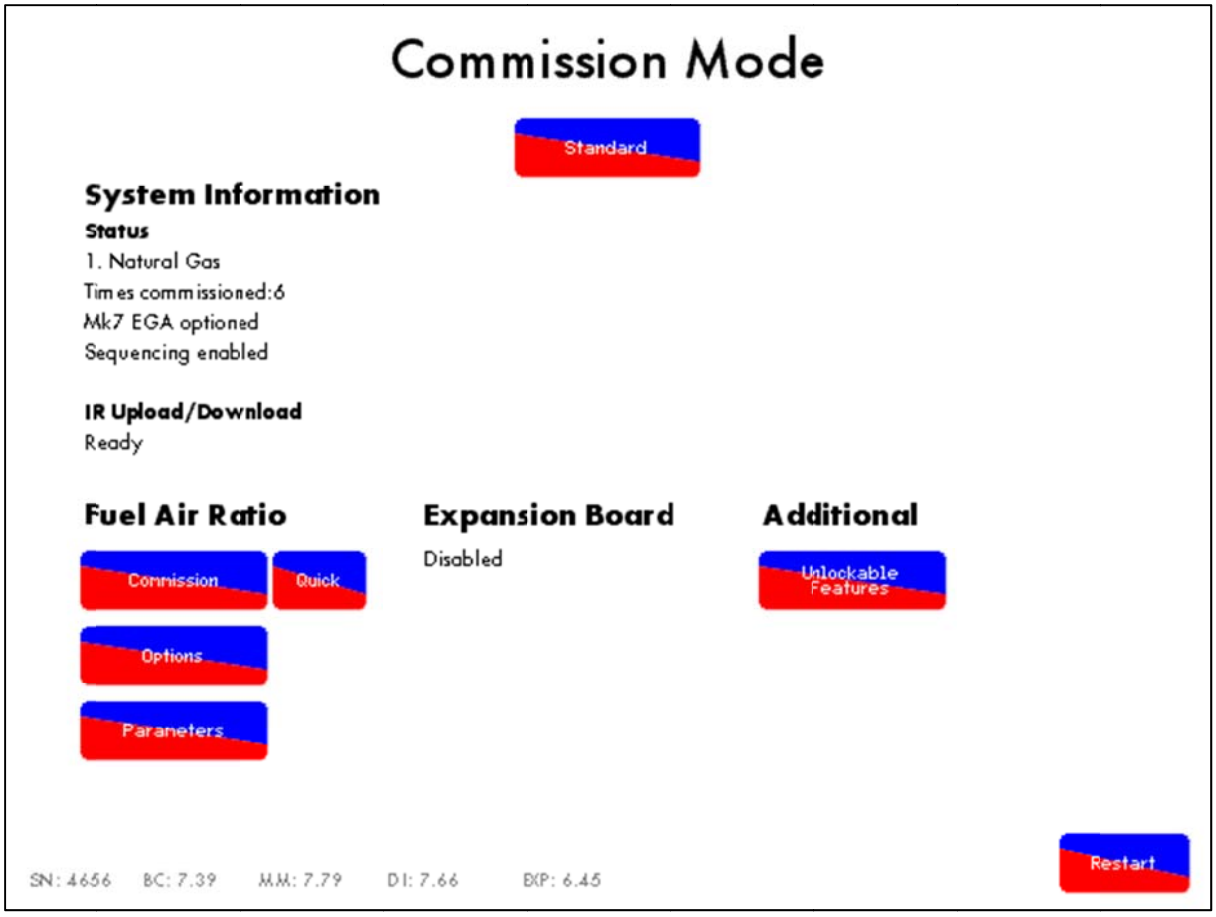


Figure 3.4.3.i Quick Commission

Quick Commission is a function on the Mk7 M.M. that has been added so that the burner can initially be commissioned quickly when using an E.G.A. for combustion trim. This allows the commissioning engineer to quickly enter a full combustion curve in situations where there is a low demand for heat or steam. Entering the fuel rich and air rich data for the combustion map can sometimes take too long. Single point changes can then be accessed at a later time to add trim to the curves, please see section 3.4.9. To use Quick Commission, set parameter 74 to 1. Quick Commission follows:

1. On the commissioning screen you must select the Quick Commission button.

2. During commissioning, the M.M. will not invoke the auto commission time of 60 seconds either side of the commissioned point to build a combustion map. On completion of an entered point the M.M. will to move to continue entering the fuel/air paired values for the next point.

3. Single point change must be used to add trim to the points on the curve. While in single point change, re-entering the points on the curve will force the M.M. to sample fuel rich and air rich, adding combustion data to the previously commissioned data. This allows the engineer to manage the plant load while the trim values are stored by entering the points in no set order.

4. When viewing the combustion map (section 3.4.4) each point on the fuel curve that has not had trim added (not been re-entered during single point change) will display the commissioned values in yellow. All of these points must be entered for the trim function to operate correctly.

Note: It is not possible to use quick commission function with an O_2 trim interface module.

3.4.4 Combustion Map

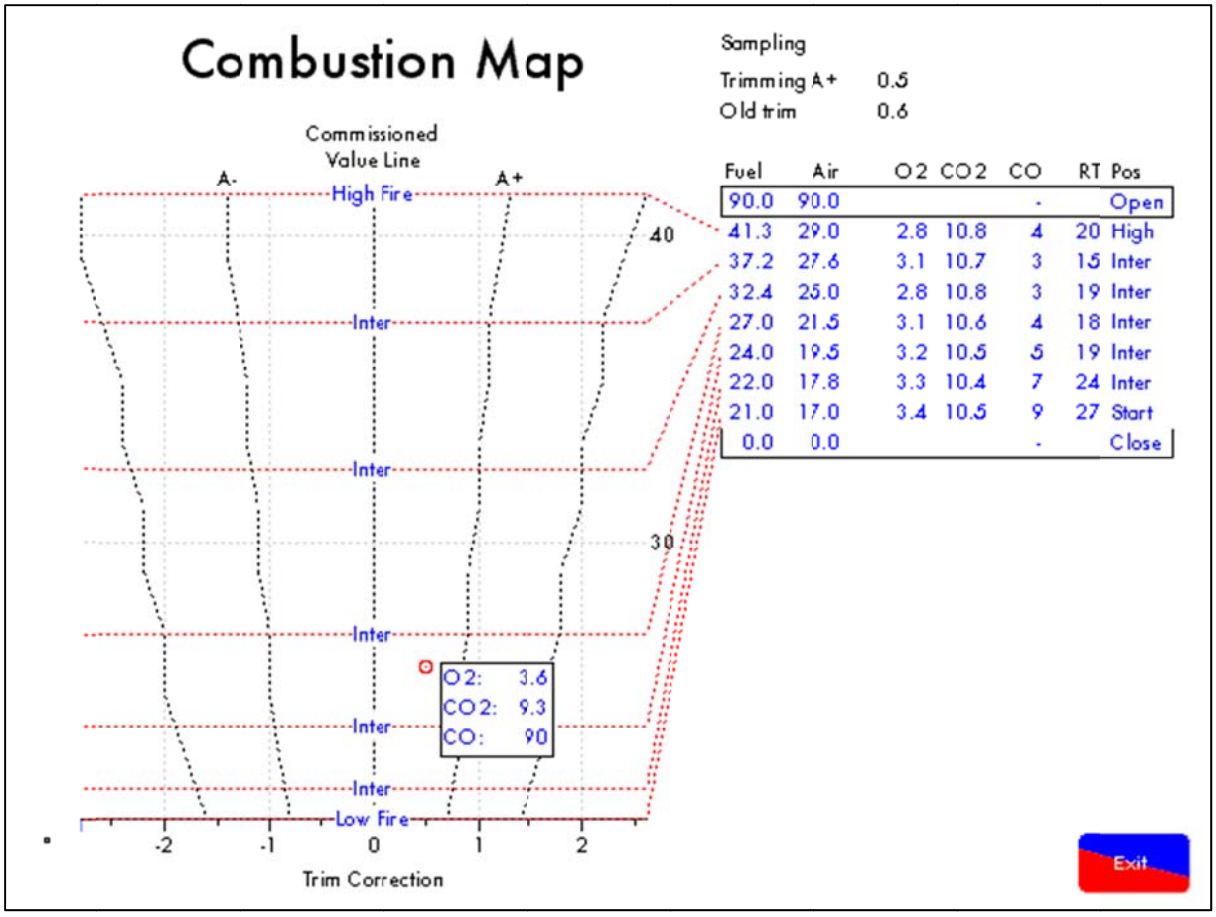


Figure 3.4.4.i Combustion Map Screen

The combustion map screen is enabled by setting Parameter 74 to 1 prior to commissioning the Mk7 M.M. and also requires an E.G.A. to be optioned.

The combustion map gives a real time visual indication of the 3 parameter trim function working to keep the combustion levels as near as possible to the commissioned combustion levels. The combustion map clearly shows the fuel curve positions on the right along with the commissioned E.G.A. values for O_2, CO_2 and CO. The graphic on the left of the screen shows the amount of trim being added or subtracted by the Mk7 M.M. to control the emissions values. The red circle indicates the current position of the trim and the current combustion values.

3.4.5 Pilot Turndown/ Check Switch Facility

When the system is in commissioning mode only, a facility has been provided that enables a commissioning engineer to pause the ignition sequence of the burner. If the lockout button is pressed during the first safety time the burner control will 'pause' at this position. This enables the commissioning engineer to make adjustments to the start gas flame. If the flame goes out during this time a lockout is set after 15 seconds. If the flame is present and the 'pause' condition is left indefinitely a lockout will be set after 10 minutes. If the lockout button is pressed again the ignition sequence continues. While paused the lockout button in Mk6 mode will flash with a light blue dot. The 'pause' facility can also be activated during the pilot prove and main flame prove phases. When the system is in a run mode the facility is disabled.

****WARNING****

IT IS THE RESPONSIBILITY OF THE FACTORY TRAINED TECHNICIAN TO ENSURE THAT USE OF THE PAUSE FACILITY DOES NOT LEAD TO A HAZADOUS SITUATION. FAILURE TO DO SO WILL RESULT IN SERIOUS EQUIPMENT DAMAGE, CRITICAL INJURY OR DEATH.

3.4.6 Golden Start

This facility enables an ideal ignition/start position to be set into memory that is not necessarily low flame or indeed part of the standard modulating load index.

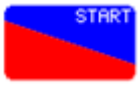
To enable this facility set Option 29 to 0 (default setting is 1).

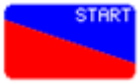
To disable this facility set Option 29 to 1.

To implement this operation enter commissioning mode i.e. press 

during start-up.

Enter the password and press Continue.

The normal commissioning process (see section 3.4.1 steps 1 to 11) will then begin by entering the close, open and light off positions as you would do during a normal commissioning. After the light off position has been entered the 

button blue dot will flash again. This is indicating the M.M. requires the Golden Start Position. Press the 

button and the blue dot will stop flashing and use the 
buttons to change the servo positions as you would for changing any normal point on the combustion curve.

Once the correct Golden Start Positions have been found press the 

button to enter the Golden Start Position and continue the commissioning process as normal.

If the burner has already been commissioned then, powering down the M.M. unit before entering the High Fire position will only make a change to the Golden Start position not to any other positions on the combustion curve.

NOTES:

1. The Golden Start position of the fuel and air servomotors is completely independent from the modulating load index and commissioned value data.
2. The facility is particularly useful on combustion systems with large turndowns and when firing heavy oil, as it enables the burner to start/ignite at a fuel rich position and then, after a stable flame is established, return to the commissioned combustion curve.
3. The Golden Start position needs to be entered for each required fuel.
4. The time the M.M. holds the Golden Start position for is adjustable via Parameter 15 (default value is 15 seconds, range 0-100 seconds). This timer starts from the ignition point. After this time the air damper will open and the fuel valve will stay in the same position until the fuel/air ratio is on the commissioned combustion curve. At this point the M.M. will start to modulate based upon the load demand and the PID control.
5. It is important to appreciate that the Golden Start position is completely independent of the fuel/air ratio values that are entered for the normal combustion curve.

3.4.7 Flue Gas Recirculation (FGR)

Flue Gas Recirculation (FGR) is a method whereby a quantity (approximately 15%) of the boiler flue gases are fed back to the burner and mixed with the combustion air. The virtue of FGR is the reduction of NOx gases. With the FGR facility, servomotor channels 3 or 4 can be used to control the amount of flue gas fed back. It is not good practice to feed back the gases when the flue gas is cold, so all the elements (i.e. servomotors and VFD's) can be set at 'FGR' positions until the gases are hot. During this time the elements (CH3 or CH4) controlling the FGR would normally be set closed. Once the gases are hot, modulation takes place in the normal way using the curve entered during commissioning.

To ascertain if the gases are hot a number of options have been added:

Option 48
A time in seconds that the FGR positions are held for. This timer starts at the end of main flame proving, once the timer is finished modulation takes place. If a golden start is used in conjunction with the FGR start then the FGR start timer will begin at the end of the golden start timer.

Option 49
An offset below the required setpoint. All channels are held in FGR start positions until the actual value reaches the offset value below the required setpoint.

Option 50
This is an enable/disable type option. If enabled an E.G.A. must be present on the system. The FGR positions are held until the exhaust temperature value from the E.G.A. reaches 248F (120C). Once the exhaust gases reach this temperature then normal modulation will occur. It is possible to use all three of the above options in order to keep the FGR start positions. If this is done then the timer will be held firstly and then the other two options must be satisfied for release to modulation.

It is important to check the setting of Parameter 90, which determines at what time the FGR start position will be entered.

If the burner has been commissioned and it is necessary to add an FGR start position, set parameter 90 to 1, and one of the above options to enable FGR start. Then enter the commissioning mode and after the start position is entered the M.M. will prompt for the FGR start position to be entered. After this is entered the M.M. can be reset and this FGR start position will be stored in the memory.

Note: Golden start takes priority over FGR. Once the golden start timer has finished, the servomotors will go straight to the FGR start position.

3.4.8 Online Changes

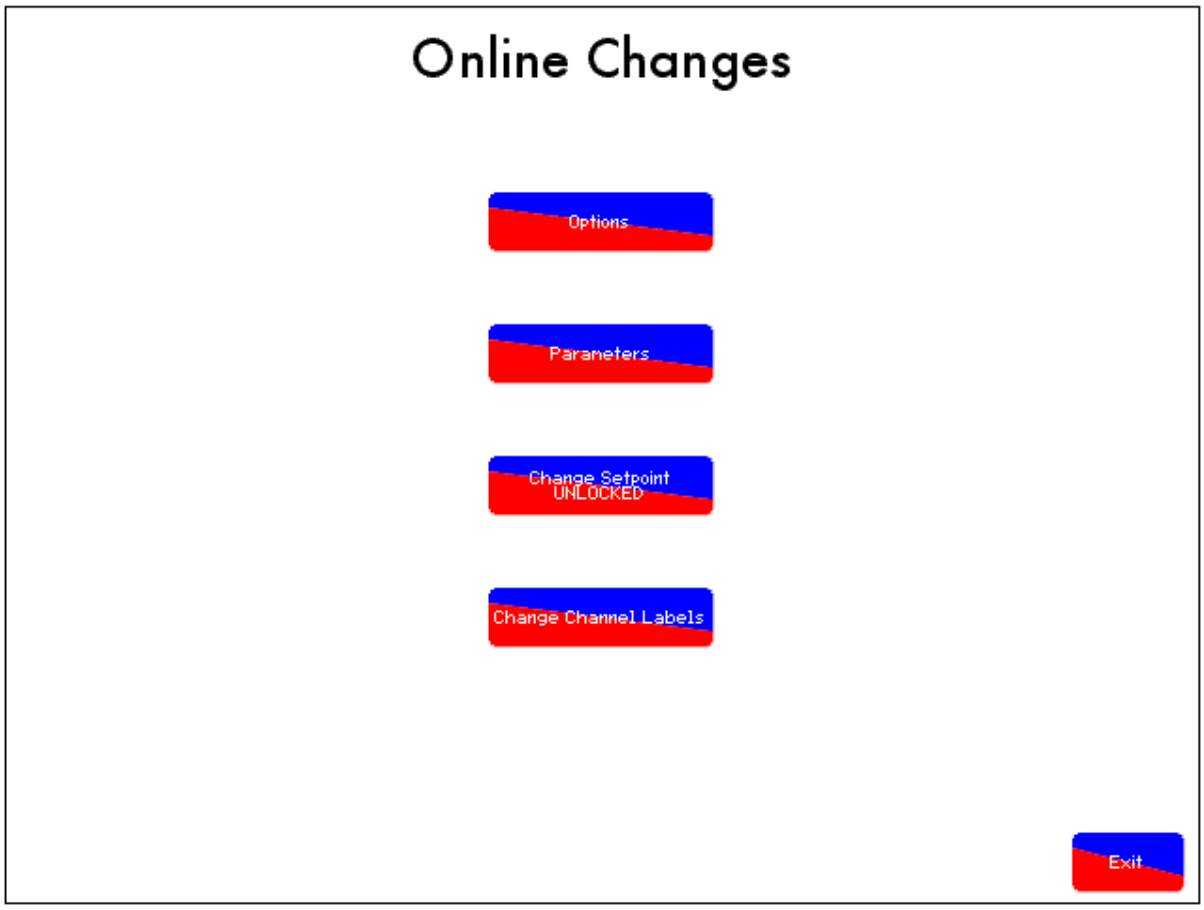


Figure 3.4.8.i Online Changes

In the M.M. Configuration screen press Online Change to make the following changes from the Online Changes screen shown in 3.4.8.i it is possible to do the following:

1. Go into either the Options or Parameters screens to change non-safety critical options and parameters while the burner is firing.

2. Lock the setpoint or unlock the setpoint by pressing the "Change Setpoint" button. Locking the setpoint will mean that you will not be able to change the setpoint on the boiler status screen. Exit once the change has been made for it to apply.

3. Change the channel labels by pressing the "Change Channel Labels" button. When in this screen press the channel label you wish to change and a keypad will appear with a list of options that the channel label can be changed to. Enter the number of the options you wish the channel label to be changed to and press the Enter button. Once satisfied, press the Exit button to store the channel labels and exit.

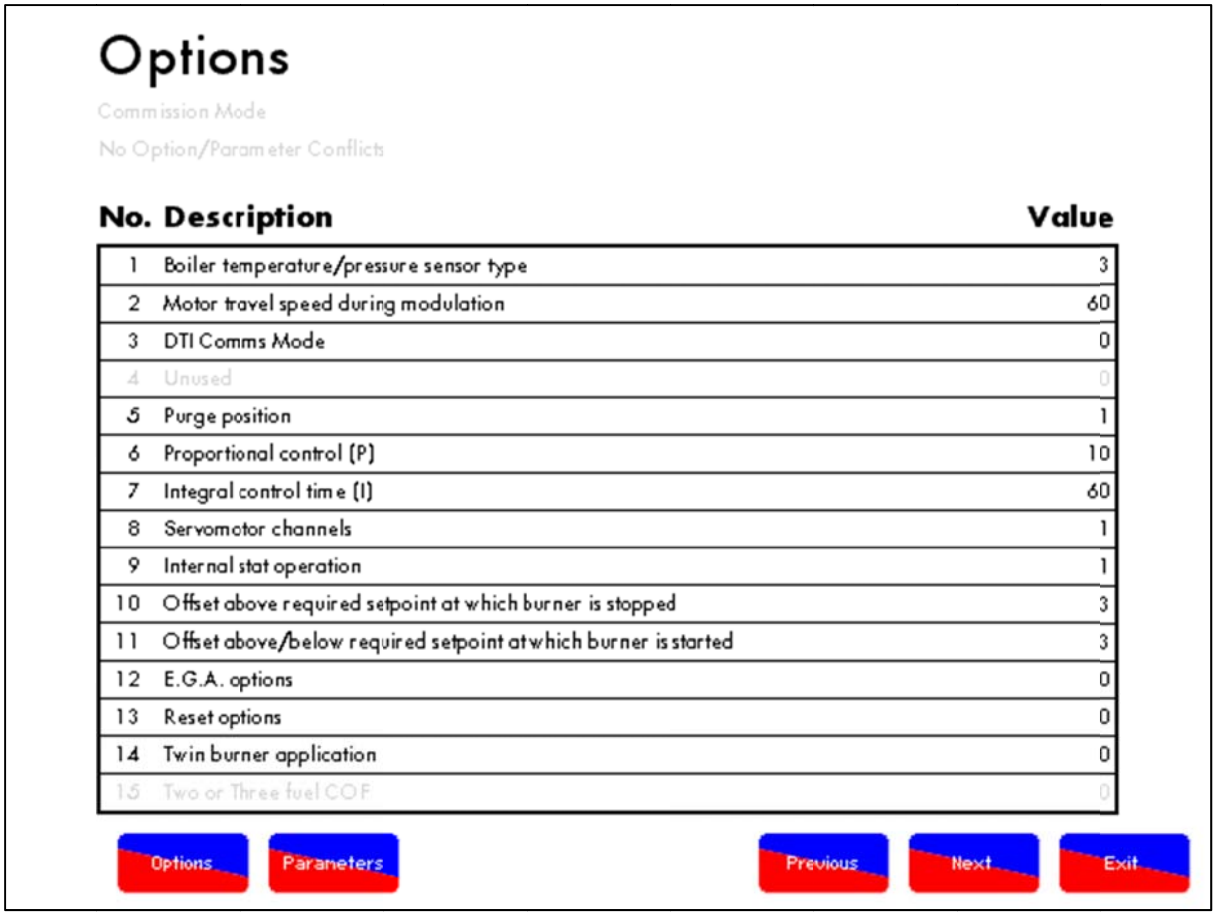


Figure 3.4.8.ii Online Changes Options

You can change the Options and Parameters online by doing the following:

1. Press the Online Changes button in the home screen and enter the online changes password in the keypad, select Options or Parameters, see figure 3.4.8.ii.
2. Select the option you wish to change by pressing on the text. The screen for the selected option will appear. If the option or parameter requires a value within a range use the Decrease and Increase buttons to select the value required. If the option or parameter requires a value from a given set then select the value by pressing the on the text itself.
3. Navigate through the various screens using the Previous and Next buttons.
4. Once the desired options/parameters have been set altered press the Exit button to save the changes and exit the online changes.

Note: Accessing "Online Changes" will not allow you to change the safety options and parameters 110 – 150, and those for the system configuration i.e. E.G.A. mode, twin burner operation and hot water or steam system.

3.4.9 Single Point Change

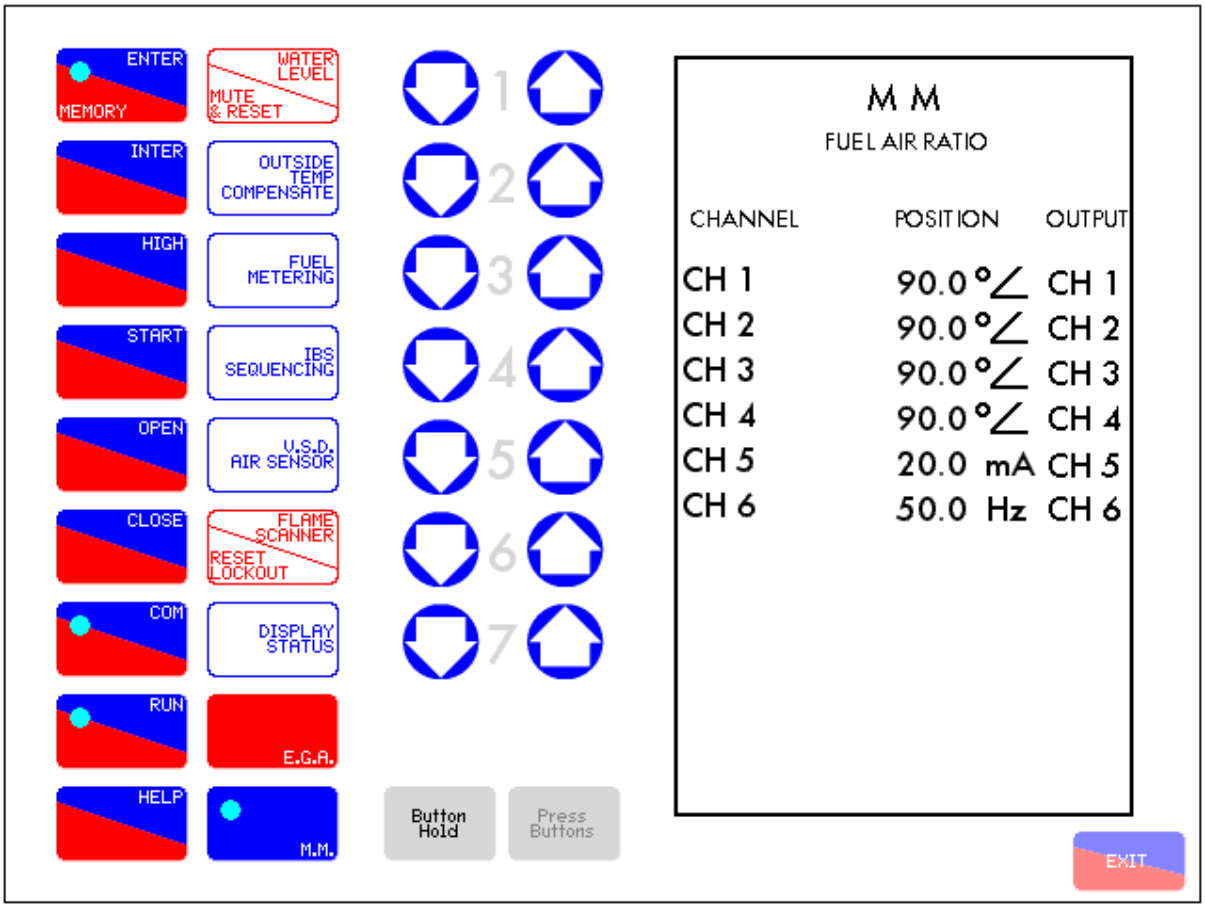


Figure 3.4.9.i Single Point Change

Single Point Change is only available while the burner is firing. At all other times, the 

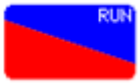
button is disabled.

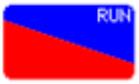
The fuel and air positions are commissioned via the Mk6 mode screen. The M.M. will switch to the Mk6 commissioning screen automatically for Single Point Change.

In order to successfully carry out Single Point Change, follow these instructions:

1. Press 

button in the System Configuration Screen.
2. Enter the password using the number pad and press Continue; the M.M. will now switch to Mk6 mode.
3. Both 

and 

will begin to flash. If you do not wish to proceed with single point change, press 

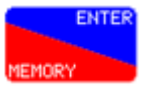
followed by 

. To begin Single Point Change, select the point to be changed using CH1 

buttons and press 

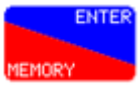
to begin modifying the point selected.

4. At this point all Channels (CH1 – CH7) can be modified using the appropriate 

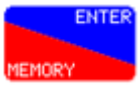
buttons. The displayed positions are the current positions of the servomotors.
5. Once the current point has been modified to match requirements, press 

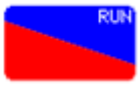
to store the new commissioning data. If an E.G.A. is optioned, press 

and a timer (Parameter 4) will appear and begin to count down. During this time, the 

button is disabled. If the emissions are satisfactory, press 

to perform air rich and fuel rich quick commission trim. The commissioning data will now be stored.
6. Use CH1 

to select the next point to be changed, followed by 

to edit that point.
7. Repeat steps 4-6 for each commissioned point to be changed.
8. One satisfied, press 

followed by 

to resume normal operation.

Note: The E.G.A. must be ready and sampling before entering single point change.

Note: Fuel flow metering must be re-entered if changes to the combustion curve are made in single point change mode.

4 ERRORS AND LOCKOUTS

4.1 M.M. Errors

Self-Diagnostic Fault Identification Software

The "Error Checking" software, which is included in every M.M. module, continually interrogates the system for component or data handling failure. This intensive self-checking programme is inflicted on all peripherals such as servomotors and load detectors as well as the main M.M. system hardware. The safety related areas, both hardware and software, have been examined and accepted for CE, UL, and FM.

Any error identified by the system is indicated by "ERROR" being displayed and the relevant error number. In the case of E.G.A. related faults, "ERROR EGA" is displayed, please refer to the E.G.A. Set-Up and Trim Guide manual.

To reset an M.M. error the unit must be reset. Lockouts can be reset by pressing the 'Reset' button for three seconds or line input voltage on terminal 56.

Error Fault Type	**Code No**	
CH1 Positioning Error	01	Check wiring & motor (Voltage should be between 0.21V and 3.6V)
CH2 Positioning Error	02	
CH3 Positioning Error	08	
CH4 Positioning Error	09	
CH1 Gain Error	41	Check wiring & potentiometers are zeroed correctly
CH2 Gain Error	42	
CH3 Gain Error	43	
CH4 Gain Error	46	
CH5 VSD Error	80	CH5 variable speed drive error
CH6 VSD Error	81	CH6 variable speed drive error
CH5 VSD Feedback Error	83	CH5 variable speed drive feedback signal different to commissioned values
CH6 VSD Feedback Error	84	CH6 variable speed drive feedback signal different to commissioned values
Load Detector	03	Open circuit on load sensor
12V/5V Supply Error	44	Internal 5V/12V supply outside limits. Check 12V on Terminals 40 & 41
Gas Sensor Re-commission Error	GAS RECOMM	Reset Option/Parameter 150 back to 0 and reset Options/Parameters 136/137 back to original values
Air Sensor Re-commission Error	AIR RECOMM	Reset Option/Parameter 150 back to 0 and reset Option/Parameter 147 back to original value
Watchdog - Error CR2	45	Unit hardware failure Option/Parameter 110 is set to 0

Error Fault Type	Code No	
A/D Converter Error	47	Check 12V supply on terminals 40, 41
Twin Burner Communications Failed	100	Flashing error – no communications between the M.M. units
Air Pressure Outside Limits	82	During run mode actual air pressure outside limits, commissioned +/- 0.3 "wg (see Option 147)
Gas Pressure Sensor MM70008 optioned together with psi units	110	See options 124 & 133 to 137. PSI display cannot be chosen for this sensor range
WL probes detected WL not optioned Check WL configure	251	Water level probes are detected but the M.M. is configured for operation without the water level. Check the second password screen
Incompatible WL software		Software set mismatch

4.2 Burner Lockouts

Lockout Message	Cause
CPI input wrong state	Proof of closure switch opened during ignition sequence Check Terminal 55 and proof of closure switches (CPI = close position interlock / proof of closure)
No air proving	No air pressure during start/firing Check Terminal 54 and air switch
VPS air proving fail	Leak detected during 'air proving' part of VPS Check 1st main valve
VPS air zeroing fail	Valve opens to vent, zero value outside limit +0.5 to -1.0" wg Check vent valve
VPS gas proving fail	Leak detected during 'gas proving' part of VPS Check 2nd main valve and vent valve Check pilot valve if using single pilot (Option 130)
VPS gas pressure low	Gas pressure below minimum application pressure Check Option 136 for minimum allowable pressure
No flame signal	No flame signal during ignition/firing
Simulated flame	The flame is present when it should not be. Call for service immediately. This is potentially a dangerous condition.

Lockout Message		Cause
Fail safe relay fault	57	These terminals are self checked within the Mk.7 M.M. If a voltage is detected when the output is off (and vice versa) a lockout occurs.
Vent valve output fault	62	
Main gas output 1 fault	61	
Main gas output 2 fault	60	
Start gas output fault	59	
Motor output fault	58	
Ignition output fault	63	
Shutter fault		UV signal detected during shutter operation on UV self check Check wiring on Terminals 21/22
Prolonged lockout reset		Prolonged voltage present on Terminal 56/lockout reset button permanently pressed
No CPI reset		Proof of closure switch not made after valves closed after firing Check Terminal 55 and proof of closure switches
Gas pressure low limit		Gas pressure low limit exceeded when using a gas sensor Check Option 136
Gas pressure high limit		Gas pressure high limit exceeded when using a gas sensor Check Option 137
Gas pressure low		Low gas pressure before start up
UV short circuit		Connections to UV tube shorted
IR Scanner comms timeout		IR scanner optioned but no IR scanner communications detected. Check wiring and fuse 6(500 mA)
Oil pressure low limit		Oil pressure low limit exceeded when using an oil sensor Check Option 139
Oil pressure high limit		Oil pressure high limit exceeded when using an oil sensor Check Option 140
Purge air pressure low		Insufficient air pressure during purge Check Option 141
Option #141 incorrect		Option 141 is set without Option 148
Freeze timeout		Pilot turndown test time exceeded (10 minutes)
Terminal 86 inverse		Terminals 85/86 both have an input or Terminals 85/86 both do not have an input when using the flame switch or IR sensor operation- see Option 122.
Terminal 85-86 fault		Electronics fault on either Terminal 85 or 86.
Prove CCT fail		Loss of input on Terminal 52. Terminal 52 must see an input at all times from the position to purge to the end of the post purge (CCT = closed circuit).

Lockout Message	Cause
Watchdog fault 1a Watchdog fault 1b Watchdog fault 1c Watchdog fault 1d Watchdog fault 2a Watchdog fault 2b Watchdog fault 2c Watchdog fault 2d	Internal fault diagnostics – contact Autoflame and report code displayed.
RAM test failed Prom test failed CPU test failed Input fault BC input short Lockout 198, 199, 200, 201, 202	Internal fault diagnostics – contact Autoflame and report code displayed.
Terminal 86 inverse	Terminals 85/86 both have an input or Terminals 85/86 both do not have an input when using the flame switch or IR sensor operation- see Option 122.
Terminal 85-86 fault	Electronics fault on either Terminal 85 or 86.
Prove CCT fail	Loss of input on Terminal 52. Terminal 52 must see an input at all times from the position to purge to the end of the post purge (CCT = closed circuit).
Option 118 incorrect	If using the NFPA post purge (Option 135 = 2) then Option 118 must have a setting of 15 or above.
Boiler DP proving	If using boiler differential proving (Parameter 92 = 2), and the input on Terminal 85 is reset then this lockout will occur.
Gas Sensor Related	
Sensor supply voltage	12V supply to sensor outside limits (11.75 - 12.25V)
Zero low gas sensor	see Application and Possibilities manual for zero limits
Zero high gas sensor	see Application and Possibilities manual for zero limits
Signal dev - gas sensor	redundant signals from sensor do not match
Counts low - gas sensor	sensor fault - stuck on signal value
Counts high - gas sensor	sensor fault - stuck on reference value
Signal high - gas sensor	gas pressure exceeds maximum range value
Gas sensor (+ number)	sensor/Mk7 internal fault - report to Autoflame
Air Sensor Related	
Sensor supply voltage	12V supply to sensor outside limits (11.75 - 12.25V)
Zero low air sensor	lower limit is -1.0”w.g.
Zero high air sensor	upper limit is +0.5"w.g.
Signal dev - air sensor	redundant signals from sensor do not match
Counts low - air sensor	sensor fault - stuck on signal value
Counts high - air sensor	sensor fault - stuck on reference value
Signal high - air sensor	air pressure exceeds maximum range value
Air sensor (+ number)	sensor/Mk7 internal fault - report to Autoflame

4.3 Troubleshooting Guide

4.3.1 Gas/Air Sensor Diagnostics Codes

To view diagnostics codes, the M.M. must be in Mk6 mode.

They are shown at the bottom of the 

display if Parameter 83=1.

Example:

Gas	43	1001
42	42	1000
Air	50	969
51	51	970

Explanation:

	Average Signal	Pressure Signal	Reference Signal	
Gas {	Gas	43	1001	Sensor Channel 1
	42	42	1000	Sensor Channel 2
Air {	Air	50	969	Sensor Channel 1
	51	51	970	Sensor Channel 2

Typical reference signals are 1000±14. If the reference signal values display 0 or are blank then the sensor is wired incorrectly.

Each sensor has two channels. Each channel gives out two values- a pressure signal and a reference signal. The values displayed are 'digitised' signals (range 0-1023). The two pressure signals should be the same. The two reference signals should be the same.

If the two pressure signals are different by more than 10 the averaged value will show 01 and not the average of the two signals.

With no pressure applied to the sensor the pressure signal value should be between 20 and 60 (typically 40 to 50). If the reading goes below 5 then an error will occur due to a negative pressure on the sensor.

Note: These values are only displayed once the burner has been commissioned and parameters 83 and 84 set to 1.

4.3.2 UV Shutter Faults

UV shutter fault– there are two LED's on the back of the self-check UV. The red LED indicates the presence of a flame; the yellow LED indicates shutter operation. The red LED will flicker in the presence of UV light. Every 60 seconds the yellow LED will come on, indicating that the shutter is closing. The red LED should then extinguish briefly. If this is not happening check the wiring to self-check UV sensor:

Green wire = Terminal 22
Yellow wire = Terminal 21
Blue wire = Terminal 50
Red wire = Terminal 51

4.3.3 UV Problems

If the red LED's fail to illuminate but the burner operates, it is likely that the 2 wires are crossed. This must be corrected. Once corrected a full flame signal strength will be displayed/registered.

The Autoflame UV software utilises early spark termination within the internal flame safeguard control. Therefore, detection of the ignition spark is allowed. During start-up the ignition is de-energised and the pilot flame must be proven without the spark before the main fuel valves are open (safety shut off). Due to the above statement it is not necessary to have a sight tube on the UV for pick-up. This, in fact, will drastically reduce the flame pick-up.

If insufficient UV is detected, it is advised to use a swivel mount assembly (UVM60003/UVM60004) in order to obtain maximum pick-up. This will allow the commissioning engineer to reliably sight the UV for optimum performance and trouble free operation.

Note: Under no circumstances is a non-Autoflame UV scanner permitted to be used. This is in breach of all codes and approvals associated with the Autoflame combustion management system. This may lead to serious equipment damage, critical injury or death.

If a non-Autoflame scanner is required then please contact Autoflame directly for technical support. For more information on UV scanners, please refer to M.M. Flame Safeguard and Operation.

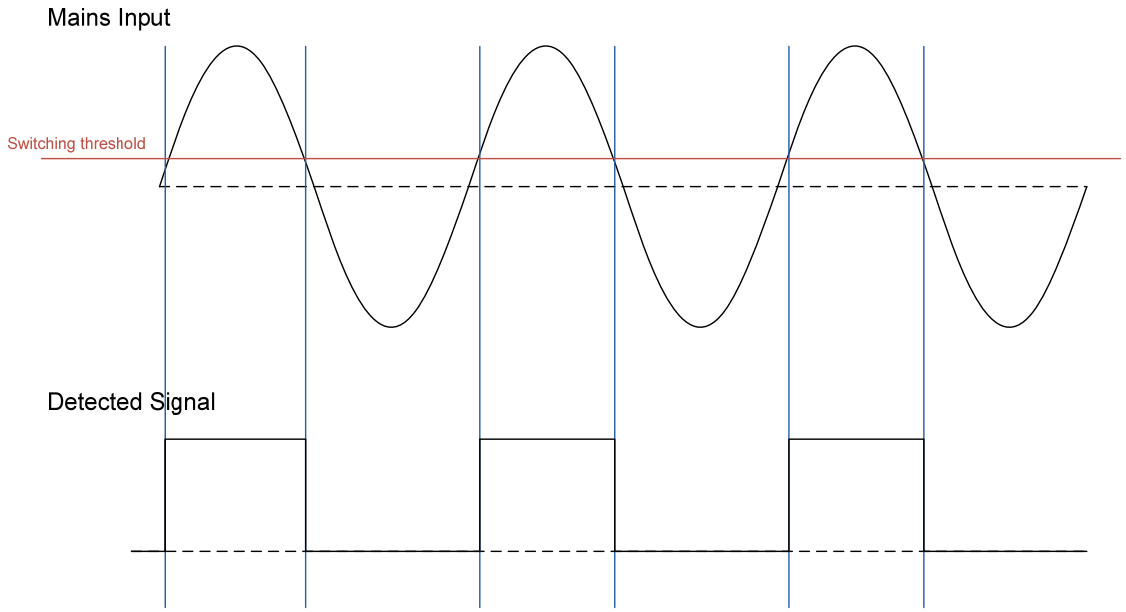
4.3.4 Further Troubleshooting

Snubbers
The Autoflame system has internal components which protects itself against voltage/current spikes and electrical interference. In some installations this internal protection is not enough, especially when the main fuel valve Terminals 60 and 61 have been connected to older gas valves and voltage/current spikes have occurred when the valves have been switched on or off. This can cause internal damage to the M.M. Snubbers can be used on these old gas valves to protect the M.M. from these spikes; they should be fitted across the power terminals of the gas valves. Please contact Autoflame Sale for more information.

Channel Positioning Error
The 'Channel Positioning' M.M. Error is caused by incorrect wiring and incorrect servomotor position. In addition to checking the wiring, and zeroing the potentiometer, please also check that the correct voltage is supplied to the servomotors, which should be ±10% of the required voltage, and the unit is earthed properly. This can cause hunting issues if not at the required voltage or incorrect earthing.

Input Fault

The 'Input Fault' M.M. Error relates to a fault with the power supply going to the M.M. The M.M. verifies the power supply going to the unit; the mains inputs are sampled to check the DC voltage. The diagram below illustrates the AC voltage that comes in through the power supply with the detected signal (digital input).



The M.M. checks the ON state of the digital signal in the mains input; the ON state of the digital input should be 50%. This means that the digital input should be in the ON state for a half-wave of the AC signal. The OFF state is safe. If the M.M. sees the digital input being ON for more than 75% across a sample period, then it will get stuck in an unsafe state. This will cause an Input Fault lockout to occur.

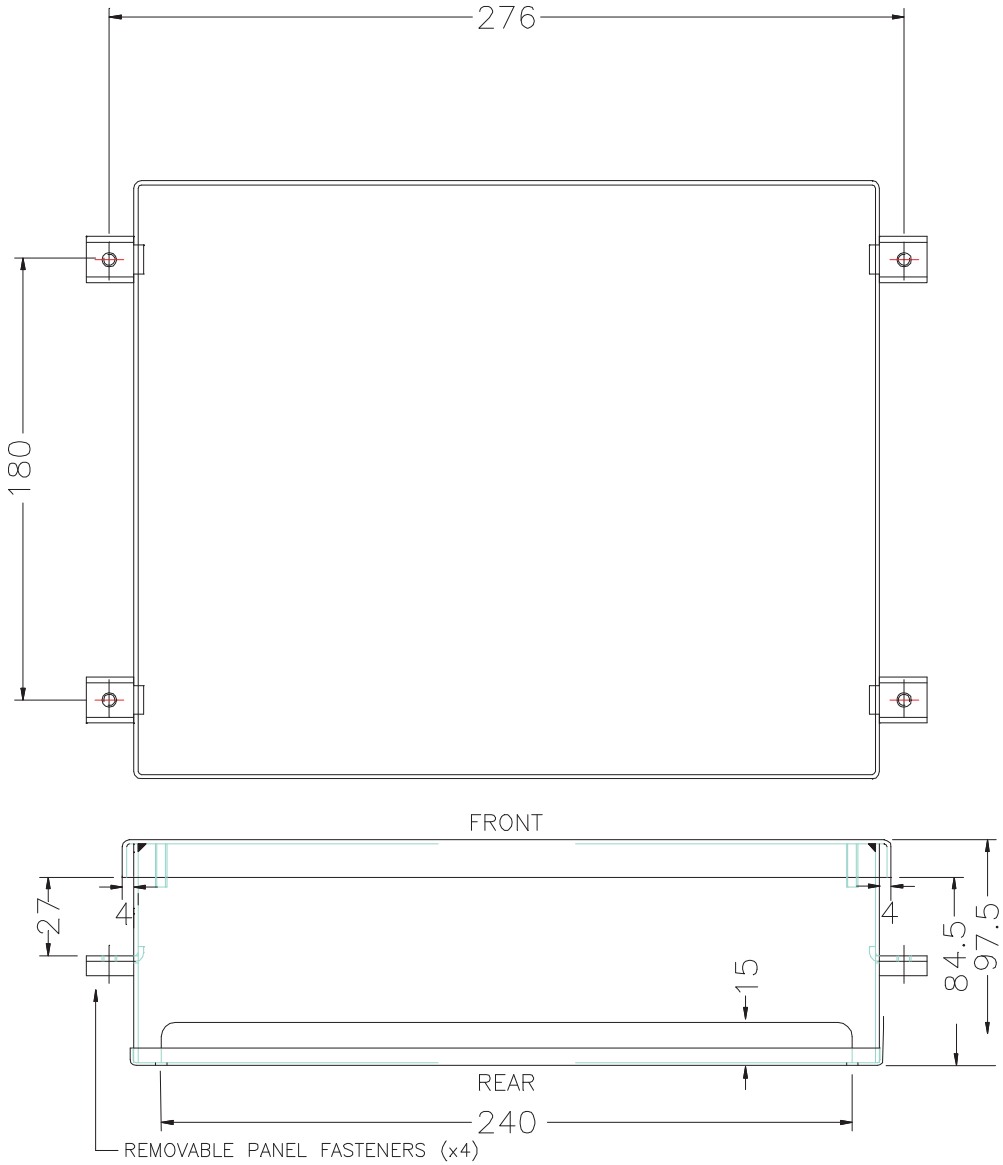
If this lockout persists, the M.M. is at risk of damaging internal components; the mains input should be checked. To troubleshoot this issue, please check for any DC voltage in the mains voltage and contact your local power supplier.

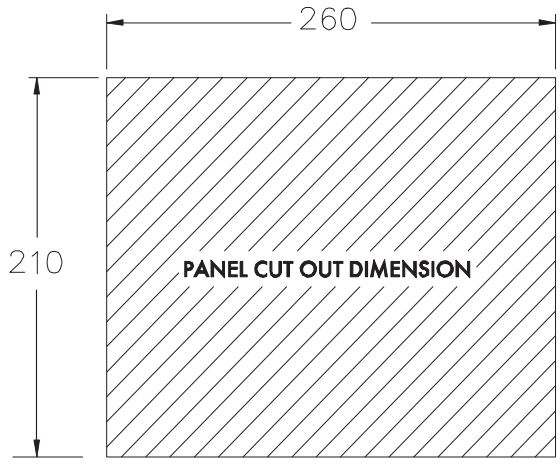
Error 44 and Error 47

If there is a fault with the 12V supply, the M.M. will display '12V-5V Supply Error' or Errors 44 and 47. Incorrect wiring for the 12V supply can cause damage to the M.M. so if Error 44 or Error 47 are displayed, please power off the unit and disconnect the 12V supply plugs (Terminals 31 to 36 and 37 to 47). Check the wiring on the terminals, as well the gas sensor, air sensor, steam pressure sensor and servomotor feedback.

5 OTHER INFORMATION AND ILLUSTRATIONS

5.1 Mk7 M.M. Fixing Holes and Cut Out Dimensions





5.2 First Out Annunciation

When the control circuit has a long series chain of various thermostats and switching elements, it is sometimes difficult to identify which element has opened the control circuit (see Figure 5.3.i below).

The First Out Annunciation can be set in any of the following ways:

Disabled- First Out does not appear on the M.M. screen (not in use).

Monitor- First Out status is viewed on the M.M. screen. The burner will continue to operate if a First Out fails.

Recycle – The burner will stop firing but will start up again once the error has been rectified with no manual intervention.

Non-Recycle- The burner will stop firing and will require a manual lockout reset for the burner to start up again.

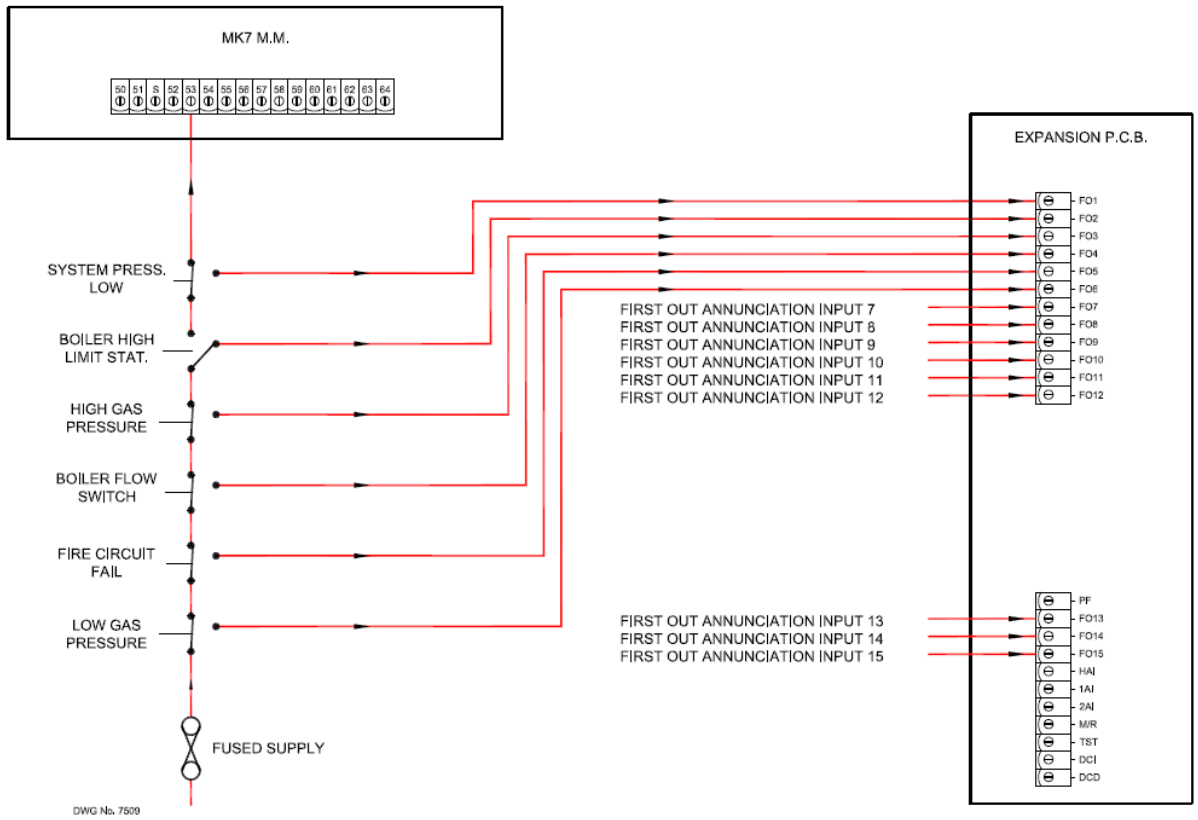


Figure 5.2.i First Out Wiring Schematic

Note: The first outs can also be set for logic low or high for indication/alarm.

For more information on First Outs, please refer to the Expansion Board Set-Up Guide.

5.3 External Modulation

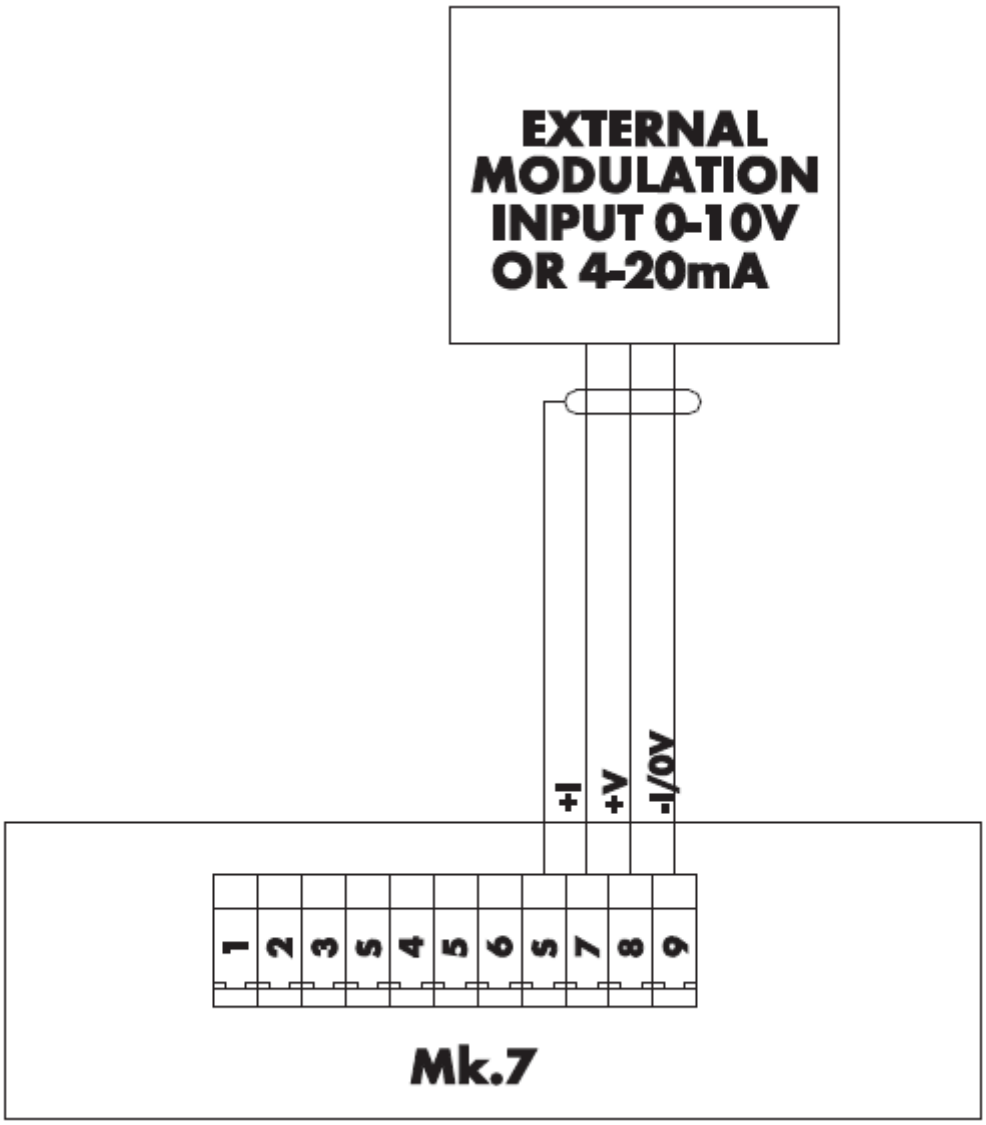


Figure 5.3.i External Modulation Wiring

For external modulation a 0-10V (2-10V) or 4-20mA (0-20mA) input is required on the terminals as detailed above. See Options 45 and 55 for setting external modulation and the two possible methods for setting this.

Important Note:

It is necessary to use a signal isolator to prevent any excessive voltages being applied to these terminals. The signal isolator used must have the following characteristics:

Signal Isolation Voltage – 3.75 kV
Creepage – 5mm
Clearance – 4mm
The equipment and cables must be housed in a clean environment – IP55

5.4 Automatic Commission of Air Pressure Values

The air pressure values for each fuel/air ratio point on the commissioning curve can be re-entered without having to carry out a full fuel/air ratio re-commission.

To invoke this facility the system must already be commissioned. Option/parameter 150 must be set to value 7 then the enter button pressed. Option/parameter 147 must be noted and set to 0- off so that air pressure limit errors do not occur while the system is running.

Start up the system as normal. Once the burner is firing the system attains the high fire positions and samples and stores the air pressure at that point. The first fuel/air ratio inter point is then attained and the air pressure again sampled and stored. This process is repeated until all fuel/air ratios inter points and start positions are complete. The new air pressure values are then permanently stored and thereafter an M.M. ERROR is set - AIR RECOMMSSION (this is to bring to the attention of the operator that options/ parameters must be adjusted back to operational settings). The error must be cleared and option/ parameter 150 set back to 0. If not set back to 0 the air values will be commissioned again and the M.M. ERROR will ensue. Option/Parameter 147 must also be adjusted to the appropriate value.

THE FACTORY TRAINED TECHNICIAN MUST NOW CHECK THE SYSTEM FOR CORRECT OPERATION.

5.5 Automatic Commission of Gas Pressure Values

The gas pressure values for VPS and each fuel/air ratio point on the commissioning curve can be re-entered without having to carry out a full fuel/air ratio re-commission.

To invoke this facility the system must already be commissioned on fuel /air ratio. Option/parameter 150 must be set to value 8 then the enter button pressed. Options/parameters 136/137 must be noted and set to 0- off so that gas pressure limit errors do not occur while the system is running.

Start up the system as normal. Once the burner is firing the system attains the high fire positions and samples and stores the gas pressure at that point. The first fuel/air ratio inter positions are then attained and the gas pressure again sampled and stored. This process is repeated until all fuel/air ratios inter and start positions are complete. The new gas pressure values are then permanently stored and thereafter an M.M. ERROR is set - GAS RECOMMSSION (this is to bring to the attention of the operator that options/parameters must be adjusted back to operational settings). The error must be cleared and option/parameter 150 set back to 0. If not set back to 0 the gas values will be commissioned again and the MM ERROR will ensue. Options/Parameters 136/137 must also be adjusted to their appropriate values.

THE FACTORY TRAINED TECHNICIAN MUST NOW CHECK THE SYSTEM FOR CORRECT OPERATION.

Once new gas pressure values for the fuel/air ratio commissioning curve have been entered, check the gas pressure displayed during VPS operation and normal firing.

6 STANDARDS

BS EN 12067-2:2004

BS EN 298:2003

BS EN 230:2005

BS EN 230:2005

BS EN 1643:2000

ISO 23552:2007

ANSI/UL 1998 Second Edition

ANSI/UL 372 Fifth Edition

FM 7610

FM 7710

Notes

IF IN DOUBT ASK AUTOFLAME TECHNICAL DEPARTMENT

MM MODULE Mk.7 Evolution

SCHEMATIC CONNECTION DIAGRAM

MM70001/E WITH OR WITHOUT EXPANSION BOARD P.C.B. 110/230Vac

FOR SUPPLY CONNECTIONS USE WIRES SUITABLE FOR AT LEAST 75°C/167°F USE COPPER CONDUCTORS ONLY

LINE VOLTAGE

LOW VOLTAGE

ALL LOW VOLTAGE WIRING TO THE CONTROL IS TO BE WIRED AS PART OF A CLASS 1 CIRCUIT

6A FUSED SUPPLY

*NOTE:
HIGH LIMIT STAT MUST BE MANUAL RESET TYPE

U.V. DETECTOR 50 51

SELF CHECK U.V. DETECTOR 21 22 50 51

YELLOW GREEN BLUE RED

EXTERNAL AUXILIARY DELAY TO PURGE

BURNER ON/OFF

* LIMIT STAT

AIR PROVING SWITCH

GAS VALVES C.P.I./POC

LOCKOUT RESET

CALL FOR HEAT

N OUTLET PRESS. INLET PRESS.

(OPTIONAL) GAS BOOSTER

BURNER MOTOR

PILOT VALVE

MAIN FUEL VALVE 1

MAIN FUEL VALVE 2

VENT VALVE

IGNITION TRANSFORMER

NOT USED

EARTH

NEUTRAL

LIVE/HOT

*NOTE:
FOR 110v, TERMINAL 69 FEEDS POSITIONING MOTORS VIA A 110-24v TRANSFORMER AS SHOWN IN DOTTED LINES.

110Vac 24Vac

* SERVO MOTORS

L CH1 CW CCW

L CH2 CW CCW

L CH3 CW CCW

L CH4 CW CCW

I.B.S. 2-PORT VALVE L N

(COMMON SYSTEM ALARM) L/O, MM & EGA ALARM OUTPUT L N

NOT USED

HIGH INTERLOCK, DELAY PURGE TIME (SEE PARAMETER 92)

OR

FLAME SWITCH AT NO FLAME STATE. 0 V LINE V

SECOND SET POINT SELECT

LEAD BOILER SELECT (IBS)/LOCAL-REMOTE PID

FUEL 1

FUEL 2

FUEL 3

FUEL 4

NIGHT SET BACK/ STANDBY WARMING

HAND

L.F.H.

AUTO

50 51 S 52 53 54 55 56 57 58 59 60 61 62 63 64 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95

NON-RECYCLING INTERLOCK

RUNNING INTERLOCK

SAFETY INTERLOCK CIRCUIT

PRE-IGNITION

FUSE 4 6.3A T T50 TO T64

FUSE 3 2A T SERVO SHORT CIRCUIT

F5 SERVO SWITCHING FAILURE 1A T AC FUSE

IR SENSOR FAILURE SHORT CIRCUIT ON 12V INTERNAL 5V

F6 500mA T
F1 2.5A T
F2 2.5A T
DC FUSES

1 2 3 S 4 5 6 S 7 8 9 10 11 12 S 13 14 15 S 16 17 18 S 19 20 S 21 22 23 24 S 25 26 27 28 S 29 30 S 31 32 33 34 35 36 S S 37 38 39 S 40 41 42 43 44 45 46 47 S

I+ +V I/OV

CH5 INPUT FROM VSD 0-10V/4-20mA

CH6 INPUT FROM VSD 0-10V/4-20mA

AUX ANALOGUE INPUT 0-10V/4-20mA — EXTERNAL MODULATION/PID CONTROLLER

CH5 OUTPUT TO VSD 0-10V/4-20mA

CH6 OUTPUT TO VSD 0-10V/4-20mA

AUX ANALOGUE OUTPUT 0-10V/4-20mA — FIRING RATE %

BLUE RED OUTSIDE TEMP. SENSOR

YELLOW GREEN

BLACK RED TWIN BURNER RS485

BLACK RED E.G.A. ANALYSER RS485

BLACK RED DTI/IBS RS485 SERIAL PORT

YELLOW GREEN I.R. SCANNER

YELLOW GREEN AIR PRESSURE SENSOR

BLUE RED GAS PRESSURE SENSOR

BLUE GREEN RED BOILER STEAM PRESSURE SENSOR *

CH1 0V W +V CH2 0V W +V

CH3 0V W +V CH4 0V W +V

POSITIONING MOTOR POTENTIOMETERS

*NOTE:
OTC MODULE TO BE USED FOR MULTIPLE UNITS, WIRES IN PARALLEL WITH DTI/IBS

BLACK RED S OTC MODULE RS485 *

*NOTE:
OIL PRESSURE SENSOR CANNOT BE WIRED IN PARALLEL WITH GAS PRESSURE SENSOR, TO USE BOTH FUEL SENSORS A RELAY MUST BE USED.

BLUE RED GREEN S OIL PRESSURE SENSOR *

EXTERNAL LOAD INPUT 0-10V *

BLUE W RED R BOILER WATER TEMP. SENSOR *

*NOTE:
THE BOILER WATER TEMPERATURE SENSOR AND THE STEAM PRESSURE SENSOR CANNOT BE USED IN CONJUNCTION WITH EACH OTHER (SEE OPTION 1).

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